the OIL AND GAS JOURNAL
PUBLISHED WEEKLY DECEMBER 18, 1961

NEWS

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Most popular crude: West Texas sour 44

Iran expects big things from Sarajeh 60

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Continuous dipmeter can help find oil 128

GAS-PIPELINE DYNAMICS . .

new approach slashes operating costs

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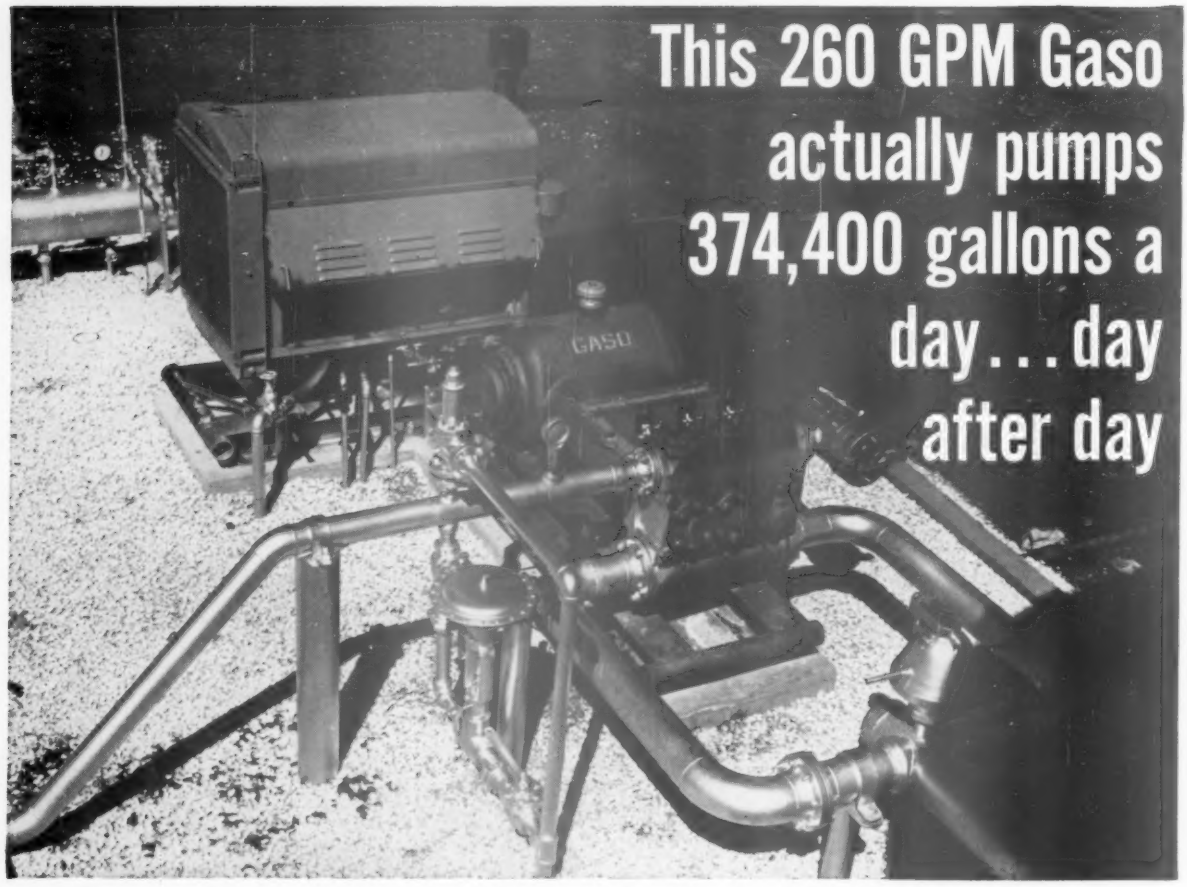
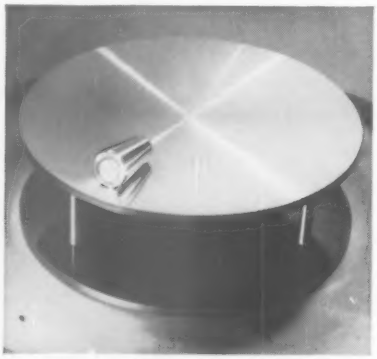


This 260 GPM Gaso actually pumps 374,400 gallons a day... day after day

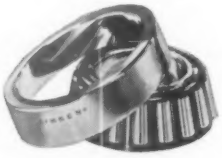
When Gaso tells a prospect that this Gaso 3600 series triplex pump is good for 260 gallons a minute, it's more than a specification. It's a promise that it will keep at it, day after day, with a minimum of maintenance. To be sure they make good on their promise, Gaso engineers specified double-row Timken® tapered roller bearings for the main crankshaft.

Each row of rollers in a Timken *tapered* roller bearing share exactly half the pure radial load in these pumps. Full bearing capacity is thus assured as the crankshaft rotates at up to 350 RPM, pumping crudes, gasoline, propane, acids, or water at pressures from 800 to 3750 psi and from 48 to 260 GPM. Along with their extra load-carrying capacity, Timken bearings permit a larger diameter crankshaft, increasing rigidity and reliability.

SERVICE from the experts is yours for the asking when you use Timken bearings. Graduate engineer salesmen work fast—right at your drawing board to help you get the most bearing capacity for your dollars.



ROLLS FOREVER in the same circle. This oscillating table demonstrates the accuracy of the taper of a Timken bearing roller. Precision manufacture assures you each bearing part carries its share of the load.



Industry rolls on

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OIL AND GAS JOURNAL
Vol. 59, No. 51

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Special section

New dynamic analysis of gas pipelines 97

By E. H. Batey, H. R. Courts, and K. W. Hannah

Good control of gas pipelines depends on a good understanding of gas flow. Here are the results of a research program to develop a thorough physical and mathematical picture of gas flow from source to load. The new approach shows how to operate the pipeline at minimum operating cost. Once the minimum fuel cost has been established, degree of automatic control to meet this objective can be found. Comparison of equipment cost and fuel savings will give potential payout. This is the first rigorous mathematical analysis of gas-pipeline flow, both steady-state and transient.

Technology

Refining-Processing

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Thermosiphon-reboiler design and cooling-water corrosion discussed at AIChE meet—Asphalt specs draw fire—Big butane splitter goes up at Amoco's Texas City refinery.

What you ought to know about refinery fires 85

By J. F. Wygant

The traditional method of designing refinery fireproofing, by blanket specification of a 2 or 3-hour ASTM fire-resistance rating, is easy on the engineer but can be hard on structures and profits. Fires can be much hotter than the standards recognize. You should look closely at fire hazards, area by area, and adjust the fire protection to fit the specific situation.

Production

Old coal mine converted to gas storage 88

By W. B. Bleakley

Peaks and valleys in the load curve were too far apart, and Public Service Co. of Colorado decided a gas-storage reservoir was needed in the Denver area. This was the beginning of what is now a successful project, and one that will increase the load factor to about 70%. A first in the industry, the completed project will store 3 billion cubic feet of gas for peak shaving.

Drilling

Two-tube pipe cuts handling, string failures 97

By Ed McGhee

Drilling contractors scattered throughout the Mid-Continent and the Rocky Mountains are trying a new type of downhole pipe which, its manufacturer claims, may save money by: (1) reducing the number of drill collars which the rig must handle; (2) reducing the frequency of failures in the drill pipe run immediately above the collars.

Pipelining

Five barges combined for a pipeline job 120

Five barges have been combined into perhaps the longest lay barge ever assembled to lay some of the heaviest, most thoroughly protected pipeline on record on the Louisiana Gulf Coast. It is a 36-in. line, just under 60 miles in length. United Gas Pipe Line Co. is installing the line from its Lirette station to Bastian Bay field.

THE OIL AND GAS JOURNAL **Newsletter**

December 18, 1961

Significant this week

Uncertainty over future of oil-import controls plagues industry. There's also a note of fear.

Some think administration's eventual decision on what to do about imports may be shaped by such factors as politics.

It's possible, of course, that controls might be dropped altogether after new study of issue is completed next year. It's also possible that controls might be tightened.

Probably the final decision will lie somewhere between the two extremes. But some things appear to be inevitable: producers face an uphill struggle in their efforts to get tighter controls, and Kennedy administration isn't going to give oil problems any special consideration. Such problems will be viewed in relation to other broad policies and plans (p. 39).

Signs of upcoming battle over imports are appearing:

Rep. Tom Steed (D.-Okla.) warned last week that producers had better get congressional action on imports in 1962 "or be prepared to try to exist with no oil-import controls" (p. 39).

IPAA is trying to get President Kennedy to reconsider his decision to postpone any significant changes in import program.

If it can't get relief from any other quarter, association may ask Congress for help in getting imports reduced (p. 40).

As it stands now, import allocations for first half of 1962 will be nearly the same as in first half of this year.

Program calls for licensed imports of 919,837 bbl. daily, including 704,116 bbl. for Districts 1-4 and 215,721 bbl. for District 5 (p. 41).

New approach to gas-pipeline analysis shows how to cut operating costs to rock bottom.

Method is outcome of research program sponsored by Dresser Electronics' SIE Division for benefit of industry. It's the first rigorous mathematical analysis of gas-pipeline flow.

Once fuel cost is determined, degree of automatic control needed to operate line most economically can be found (p. 65).

Alberta-California gas system is almost ready to go on stream.

All pipe in 1,404-mile line from prolific gas area along Foothills Belt in Alberta to gas-hungry California is in the ground. First deliveries are due by end of year (p. 52).

Keen interest is being stirred by Chicago test of storing liquefied natural gas in buried concrete tank.

Success of experiment, which stems from research sponsored by American Gas Association, would mean halving of storage costs. LNG is now kept in aboveground metal tanks.

Demonstration tank is being built of prestressed concrete. It probably will be ready for testing in February (p. 50).

Continental Oil's "year-end statement" has a switch. It's announcement of what company is not going to do in 1962.

There won't be any additions to refining capacity. Only necessary development wells will be drilled. And Continental is not going to build a lot of outlets in a marketing grab.

This restraint ties in with company President Leonard F. McCollum's suggestions that entire industry should be more realistic in planning for next year. When he was elected API chairman in November, McCollum said oil could whip its economic woes if all companies acted with foresight (p. 48).

Rotary-rig activity in U. S. has jumped to 2-year high.

There were 2,036 rigs at work during week that ended December 11. This is first time since December 1959 that count has exceeded 2,000. Upsurge will be reflected in well-completion gains during early part of next year (p. 47).

West Texas sour crude has no trouble at all in finding a market nowadays.

And that's quite a change from the situation a few years ago, when operators couldn't get rid of it. Reason for the turnabout: a matter of pricing.

Difference between West Texas sour and East Texas oil is about 30 cents per barrel at refinery gate. East Texas oil has higher gravity, but that factor isn't as important as it used to be (p. 44).

Speaking of crude: San Joaquin Valley's shallow, low-gravity fields are popular with California operators now.

State's tight crude situation is sparking this interest. As demand rises and discoveries grow scarcer, drillers are being forced to go into old fields (p. 42).

On the foreign scene:

Iran is counting on its big Sarajeh field to straighten out a fuel paradox.

Country's one of world's top-rated oil exporters, but it has growing problem of how to cope with its own fuel demand.

Sarajeh, king-size gas-condensate reservoir, may hold key to solution of dilemma. National Iranian Oil—government company developing Sarajeh—estimates reserves at 1.5 trillion cubic feet of gas, 51.5 million barrels of condensate (p. 60).

Iraqi Premier Kassim has drastically reduced areas in which Iraq Petroleum can operate.

This caused no real surprise. Fiery premier had vowed to strike at the three companies which produce Iraq's oil if they didn't go along with demands he made in series of oil talks.

Operating areas were cut to about 800 sq. miles (p. 58).

News in the making

Keep an eye on latest wildcat program in Nebraska.

It's being staged by H. L. Hunt in north-central part of state. Locations have been announced in Garfield, Holt, and Rock counties, 125 to 160 miles north of nearest production.

These three well sites lie in heart of big, nonproductive Central Nebraska basin. Success at any one of them would open entirely new oil province.

Under consideration: possibility of using nitrogen for pressure-maintenance program in Clear Creek field, McKenzie County, North Dakota.

Production is from Madison at 8,700 to 9,000 ft. Supply of nitrogen in shallower Heath formation has stimulated proposals for nitrogen flood.

Nine of the first 10 wells drilled in field, which was found in 1958, were producers with cumulative production of better than 400,000 bbl.

Expect start of construction on Matador Pipe Line's link between North Dakota oil fields and Interprovincial Pipe Line at Cromer, Man.

Last hurdle—clearance by Canada's Supreme Court—has been surmounted.

Connection will mean all-pipeline route to Duluth-Superior and Minneapolis-St. Paul refineries. At present they get North Dakota oil by rail.

Japan's total chemical-industry production should reach a level of about $8.68 billion in 1970. More than half of this, or roughly $4.5 billion, will be in petrochemicals.

That's the forecast of Japan's Ministry of International Trade and Industry. One major assumption: by 1970, imports will have been eliminated.

Interesting sidelights in this prediction: Japanese production of synthetic resin is expected to grow 15% annually during period, culminating in 2,600,000 tons per year. Ethylene production is expected to reach 1,500,000 tons with a 33% growth rate.

Wall Street reports indicate Humble is trying to acquire Paris-based Franco Wyoming Oil.

However, Franco Wyoming official says no formal offer has been received from Humble.

Last year, Franco Wyoming had U. S. oil production of 4,000 bbl. daily. Earnings were $1,966,545.

Market memo

Dec. 18, 1961

Higher product prices are giving the oil industry a brighter year-end outlook.

Heating oils are definitely improved.

Humble in effect lifted the East Coast market one-half cent a gallon by finally withdrawing summer discounts on No. 2. Others followed.

East Coast suppliers then quickly boosted all distillate prices one-fourth cent, putting important No. 2 posted price at 9 cents. And more important, the new postings give a firm appearance even before any big movement develops in the wake of current cold weather.

Near-zero weather in Midwest has put real muscle in the Mid-Continent spot price of 8.75 to 9 cents for No. 2. In fact, a price increase may be in the making.

Even **gasoline**—sick so long now—shows signs of price recovery.

Phillips' 1-cent boost to a 11.5-cent per gallon posting for regular has taken hold from Oklahoma north along the Great Lakes pipeline and has a good chance of sticking.

Refiners have suffered such a poor netback on gasoline since mid-summer they now seem determined to repair damaged markets. A **few soft retail gasoline markets** persist across the country, but there's a "go easy" feeling abroad against ruining markets by price cutting.

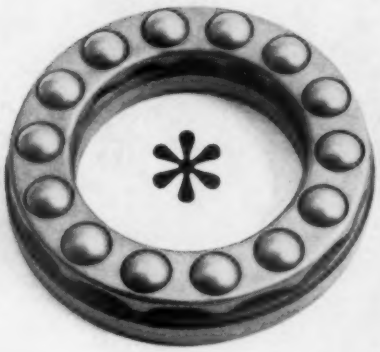
Very little excess gasoline overhangs the Gulf Coast cargo market. Only three cargoes are known to be available till the end of the year, and they're not being pushed. Talk is that firm offers might get at least one of them at three-eighths to one-half cent off. **Strike at Gulf's Port Arthur refinery** is still a factor. Company reportedly is making process deals and buying quietly.

That 17-cent **cut in Pennsylvania Grade crude** is not necessarily a trend.

South Penn Oil, in announcing cut, said it was prompted by an oversupply of the crude and chaotic gasoline markets. If others follow, 33,500 bbl. daily of the premium lube-type crude will be involved. Pennsylvania Grade crudes often move independently of other crudes.

General crude market appears firm for the moment—and should be even stronger if current price upswing in products continues.

Marketing notes: Richfield and **Tidewater** both are getting new customers from their sponsorship of anticommunist TV shows on the West Coast . . . **High gasoline taxes** cut volume, as Pennsylvania's experience continues to prove. For 9 months, state shows net loss of 41.2 million gallons compared to same period last year when taxes were lower . . . **Sohio** and Cleveland National City Bank **plan combination drive-in bank and service station** projects in suburban Cuyahoga County . . . **Sohio** also is polishing up the company image with redesigned oval signs at its service stations. Signs have Sohio lettered in red surrounded by a white oval floating in a sea of deep blue . . . **Phillips** has purchased Imperial Oil, an Owensboro, Ky., jobber with river terminal, bulk plant, and 10 modern stations . . . **DX Sunray** is launching a minor motor tune-up program for its dealers aimed at a source of additional income and boost to sales . . . **Gulf** has gone to pushing its line of specialty products on shelves of supermarkets and other retail stores. Specialties field agents have been appointed.



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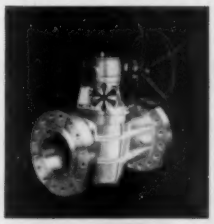
The single-unit plug-and-stem of Walworth's Rolotork Lubricated Plug Valve is mounted like the drive shaft of a fine machine tool. Superhardened ball bearings absorb thrust—as high as 100,000 pounds—yet let the valve operate without an ounce increase in torque! That's



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Rock-steady reliability is guaranteed by use of transistors and semi-conductor diodes—no moving parts, **no known failure mechanism.** Digital "computer-language" techniques eliminate transmission errors, provide computer compatibility. Functional groupings of **plug-in modules** insure easy and logical maintenance—all Dresser/SIE system **users continue employing their regular maintenance personnel and key operating people.**

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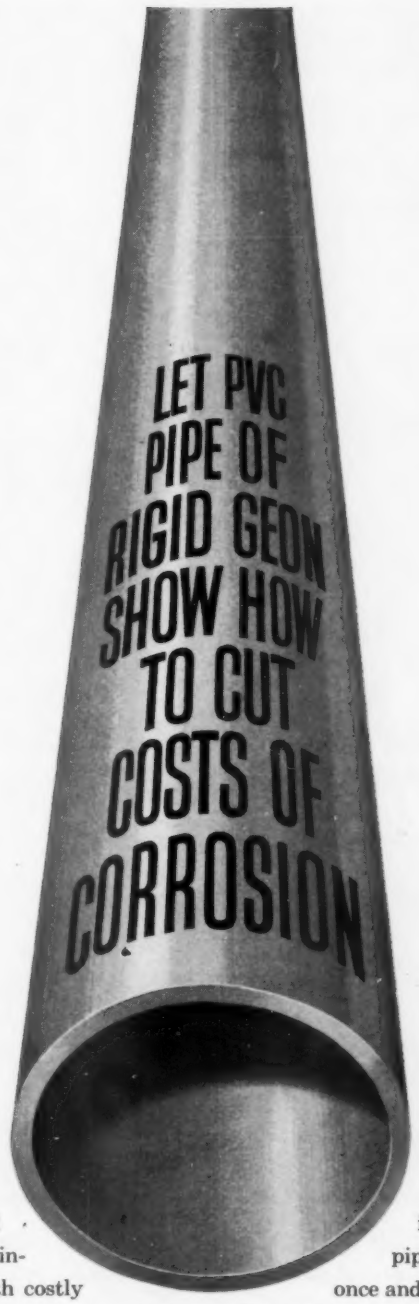

B.F.Goodrich

One look at your records should tell you how much it costs in pipeline maintenance and replacement to deal with costly corrosion. Then it is easy to measure how to save by eliminating corrosion at the start—by using pipe made of rigid Geon vinyl.

No problems from salt water, most chemicals, acid or alkaline soils, or galvanic corrosion. Pipe of rigid Geon stays smooth inside and out because it is not affected by the corrosive influences that affect ordinary pipe.

Many gas distribution companies now save by inserting Geon pipe into reamed out iron pipe—to end the maintenance problem once and for all. Others use pipe of rigid Geon at the start of new installations.

In many places, gas and oil companies are learning how lightweight, easy-to-install pipe of rigid Geon gives high tensile and impact strength, standing up well under pressure. For more facts—including experiences of gas companies—write B.F.Goodrich Chemical Company, Department NL-7, 3135 Euclid Avenue, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

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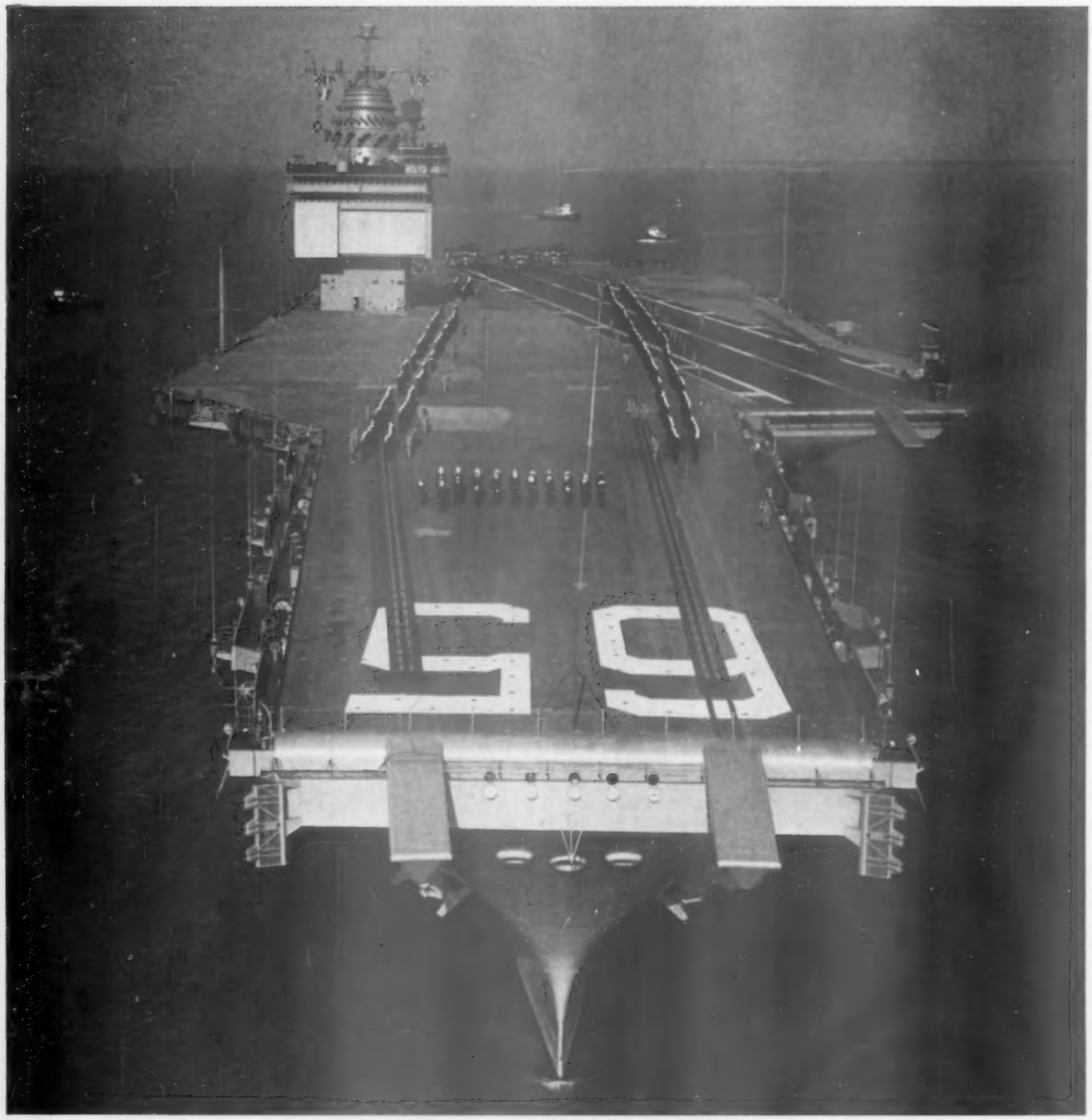

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Because of her eight reactors and extensive electronic system, no shipbuilding job was ever more complex. For 1,366 days, many constantly-changing challenges were met and surmounted. How well the men, methods and machines of Newport News discharged their responsibility for building the world's largest ship is now a matter of public and official record.

This is *enterprise at Newport News* . . . leader in shipbuilding and in the manufacturing of water power and other heavy industrial equipment.

Newport News
SHIPBUILDING AND DRY DOCK CO. NEWPORT NEWS, VIRGINIA

Reed Cobra bits are just one example of the outstanding economies made possible by Reed's continuing program of research and development. These bits are setting phenomenal records all over the oil country in both mud and air drilling. For example—

On a West Texas well, drilling with mud below 12,000 feet, four Reed Cobra bits drilled 2,289 feet in 404½ hours. On an offset well it took 37 tooth bits to drill 2,172 feet in 558 hours. On another West Texas well a Cobra bit set an air drilling record of 3,644 feet in 103 hours.

In Pennsylvania, drilling with air, it is routine for one Reed Cobra bit to complete the hole from surface casing to TD. In this area total footage per Cobra bit regularly exceeds 7,000 feet.

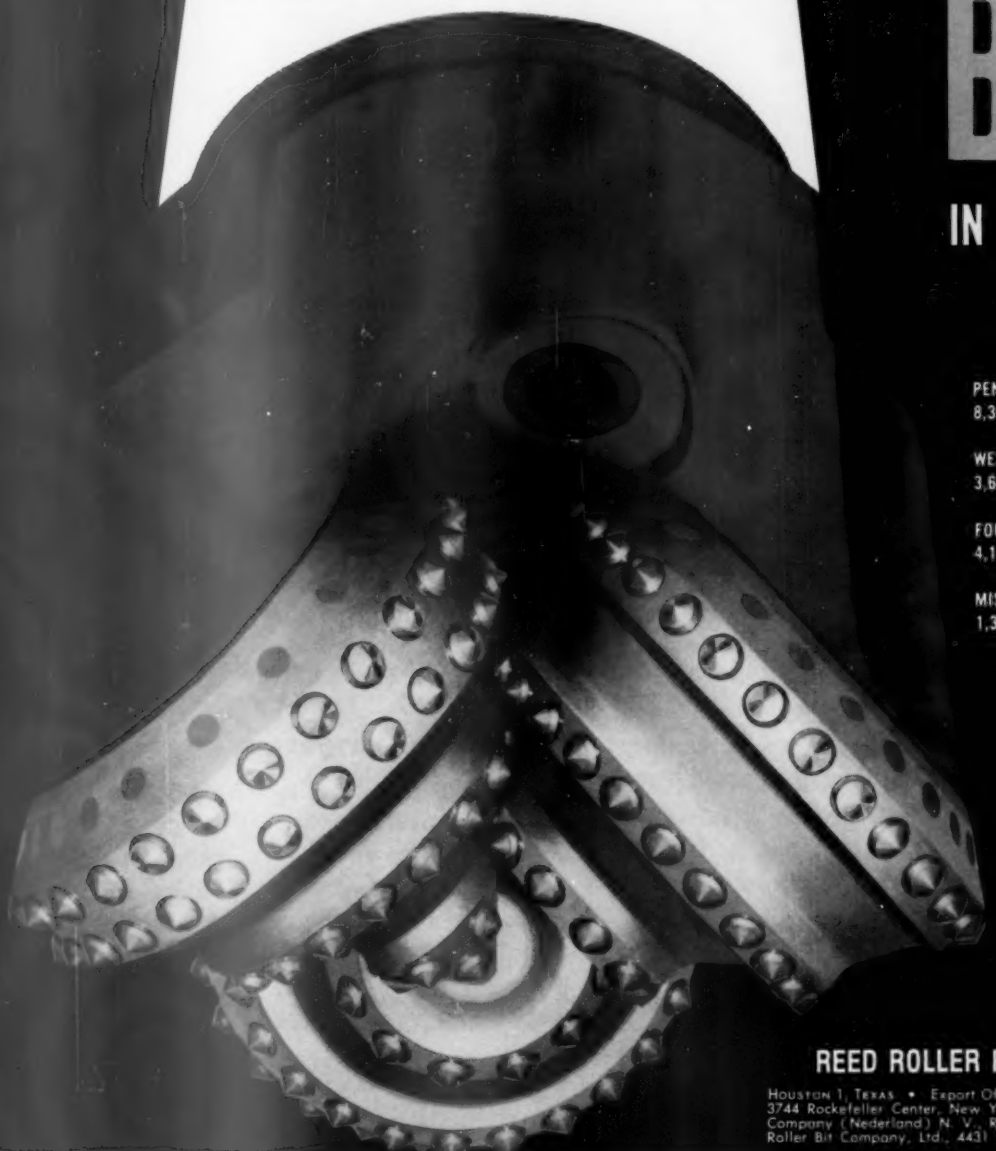
Drilling with mud in East Texas in the tough Travis Peak formation Cobra bits consistently get runs up to 250 feet. Drilling with gas in Mississippi 10 Cobra bits drilled 6,850 feet in 358½ hours. In the same vicinity more than 10 times this number of tooth bits were required to drill the same footage with mud.

There is a Reed man near you. Let him give you the full story on Reed Cobra bits and the Reed Quality Line—tool joints, drill dollars and rock bits.

PIONEERS IN EFFICIENT DESIGN

REED COBRA BITS

IN MUD OR AIR



PENNSYLVANIA — 1 COBRA BIT, 8,352 FEET IN 134½ HOURS

WEST TEXAS — 1 COBRA BIT, 3,644 FEET IN 103 HOURS

FOUR CORNERS — 1 COBRA BIT, 4,102 FEET IN 134½ HOURS

MISSISSIPPI — 1 COBRA BIT, 1,317 FEET IN 51¾ HOURS

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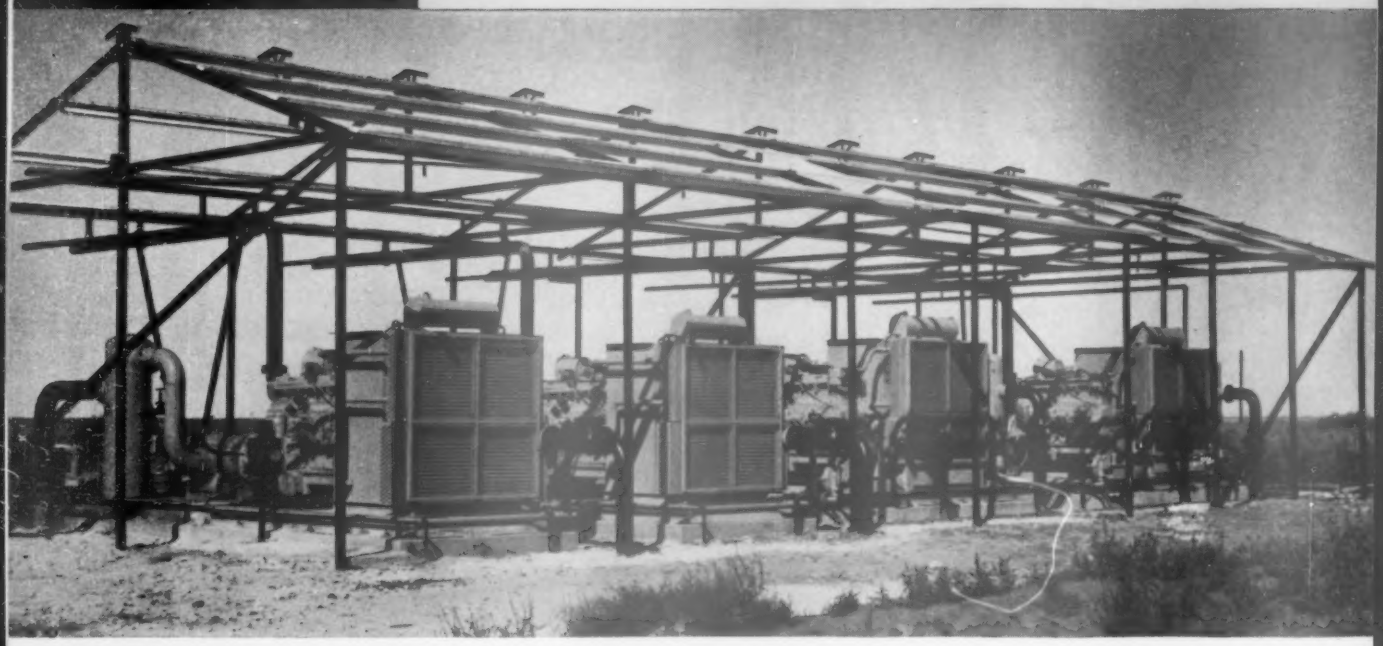
engine power
BY CATERPILLAR

A MISER ON COSTS WITH ROUND-THE-CLOCK RELIABILITY

THE CAT G342 FOR COMPRESSORS



Dependability is the first and foremost requirement for unattended compressor stations. This is why Oran Back of Borger, Texas, specified four Caterpillar G342 Natural Gas Engines to power two Worthington and two Karl-Wittig Gas Compressors near Stinnett, Texas.

The units operate around the clock, compressing 2,600,000 cubic feet of natural gas from 0 PSIG up to 150 PSIG. According to Mr. Back, the Cat Engines "have been on a 24-hour-a-day basis seven days a week ever since we first started them and they have given us no trouble whatsoever."

There are other good reasons to choose Cat Natural Gas Engines. Their basic diesel construction allows them to operate without *derating*. They offer the highest output available in gas engines their size. Over-all operating costs of the 10.5:1 compression ratio are the lowest in the industry.

See your Caterpillar Dealer or your equipment manufacturer for all the facts. They are nearby and willing to help you get the right engine to meet your needs. Your Cat Dealer is ready to back you with service and parts, too.

THE CAT G342 NATURAL GAS ENGINE

10.5:1 compression ratio	No. cylinders—6
Continuous HP—	Length—81 inches
280 @ 1300 RPM	Width—45 inches
Bore—5.75 inches	Height—65 inches
Stroke—8 inches	Weight—5240 lbs.

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VISUAL CONTROL — Halliburton's Fracometer shows at a glance whether or not preplanned injection pressure, hydraulic horsepower, fluid density, and cumulative flow in gallons are being obtained.

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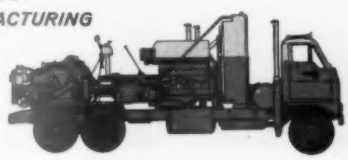

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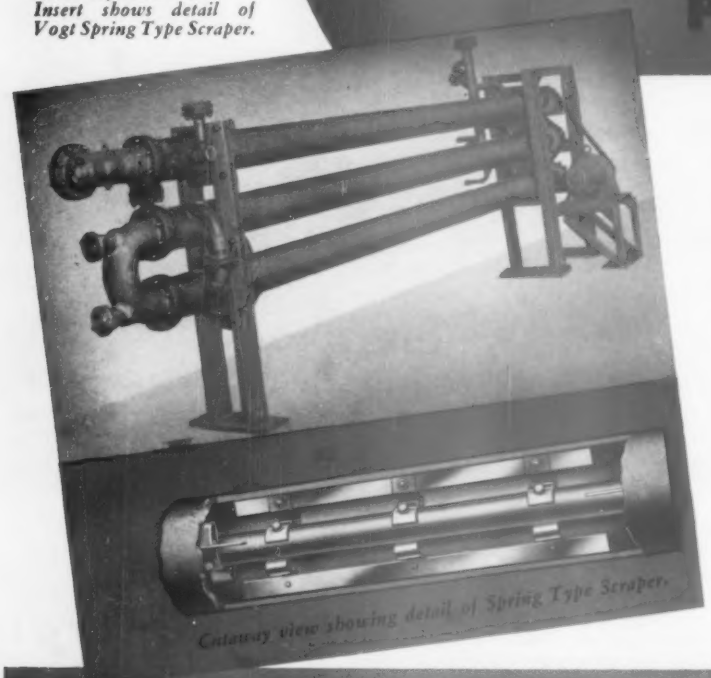
SCRAPED SURFACE EXCHANGERS *Solve* those Special Heat Transfer and Crystallization Problems . . .

BELOW: *A scraped surface unit for production of Para-Xylene by fractional crystallization. Insert shows detail of Vogt Spring Type Scraper.*



Cutaway view showing detail of Spring Type Scraper.

. . . And Here's How:

1. Rotating scraper action continuously sweeps surfaces clean even while processing highly adhesive materials.
2. Uniform rate of heat transfer keeps crystallization under control and discharges crystals as a slurry.
3. Product is thoroughly mixed by scraper blades as it flows.
4. Closed, pressure-type system permits use of flammable, volatile and expensive solvents with complete safety and no solvent loss.
5. Units fabricated from a broad range of materials to suit process stream characteristics.

Write for Literature. Address Dept. 24A-XO

Listed here is a wide variety of materials which have been successfully processed with Vogt Scraped Surface Exchangers in the chemical, petro-chemical, petroleum and related industries.

Benzene Hexachloride
Caustic Soda
Caustic Potash
Clay
Cylinder Stock
Para-Dichlorbenzene
Fatty Acid Solutions
Fish Oil
Linseed Oil
Naphthalene
Paratone & Solids
Phenolic Resins
Polyester Liquid
Pressed Distillate
Reduced Petroleum
Waxy Oil-Solvent Mix
Soybean Oil
Sperm Oil
Sugar Syrup
Sulfur-Oil Mix
Sulphate Solution
Tall Oil-Naphtha-Sulfuric Acid Solutions
Tetrachloro Benzene
Viscose
Wax Slurry
Para-Xylene

HENRY VOGT MACHINE CO.
Louisville 10, Ky.

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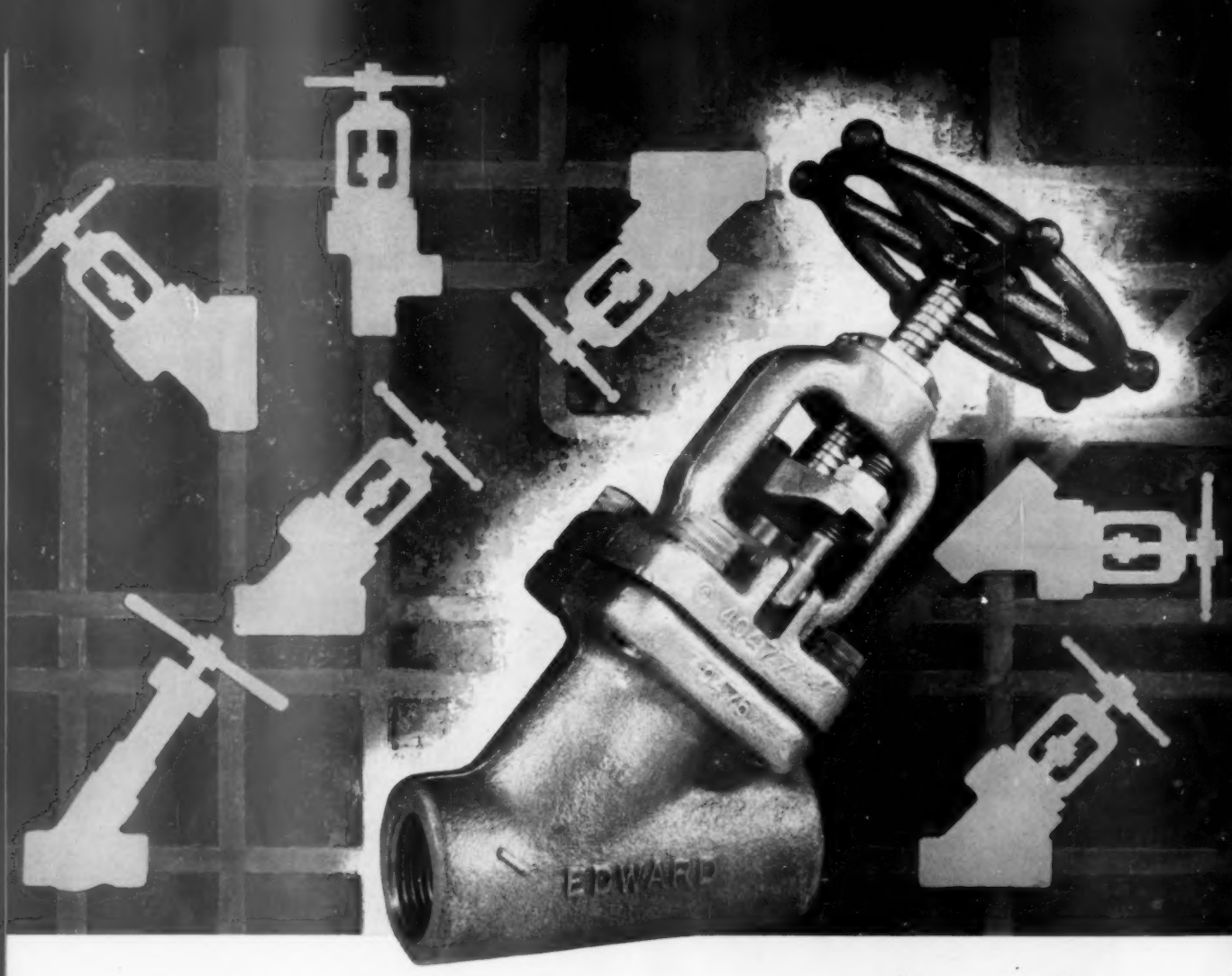
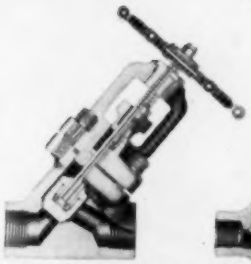


Edward Steel Globe Valves fit any oilfield or refinery piping plan

Edward forged steel globe and angle valves are perfectly designed for oilfield, petrochemical, and refinery applications. Ideal for air, water, oil, and other hydrocarbons, for steam, anhydrous ammonia and other gases . . . they resist corrosion, heat, high pressure, abrasion, and rough treatment from operators. They are available in sizes from ¼" to 2½", in both globe and angle designs, to suit any petroleum industry application. Edward globe valves feature straightway design for optimum flow, Impactor* handles for easy seating in high-pressure service, and other innovations developed in Edward's uniquely large research laboratories. Edward builds a complete line of forged and cast steel stop, check, and stop-check valves for process industries. For additional information, see your favorite distributor, or write to Edward Valves, Inc., 1212 West 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. 6015



General Purpose Globe Valve
Fig. 848, Bolted Bonnet
2000 lb WOG
600 lb at 910F
(Sizes ¼" to 1")

High Pressure Globe Valve
Fig. 158, Screwed Bonnet
10,000 lb WOG
(Sizes ¼" to 2")

Fig. 848 features new spiral wound gasket, new solid disk of chrome-cobalt-tungsten alloy, integral Stellite seat, forged steel body and bonnet, exclusive EValloy 13% chromium stainless steel stem, and new swing-style stainless steel gland bolts. Also available in angle design. Fig. 158 features EValized bonnet to resist corrosion and abrasion, and protect stem threads; replaceable screwed-in seat and swivel needle disk of EValloy 13% chromium stainless steel, Impactor* handle, Buna-N "O" rings for leakproof joints. Both valve types are available in choice of screwed or socket welding ends.

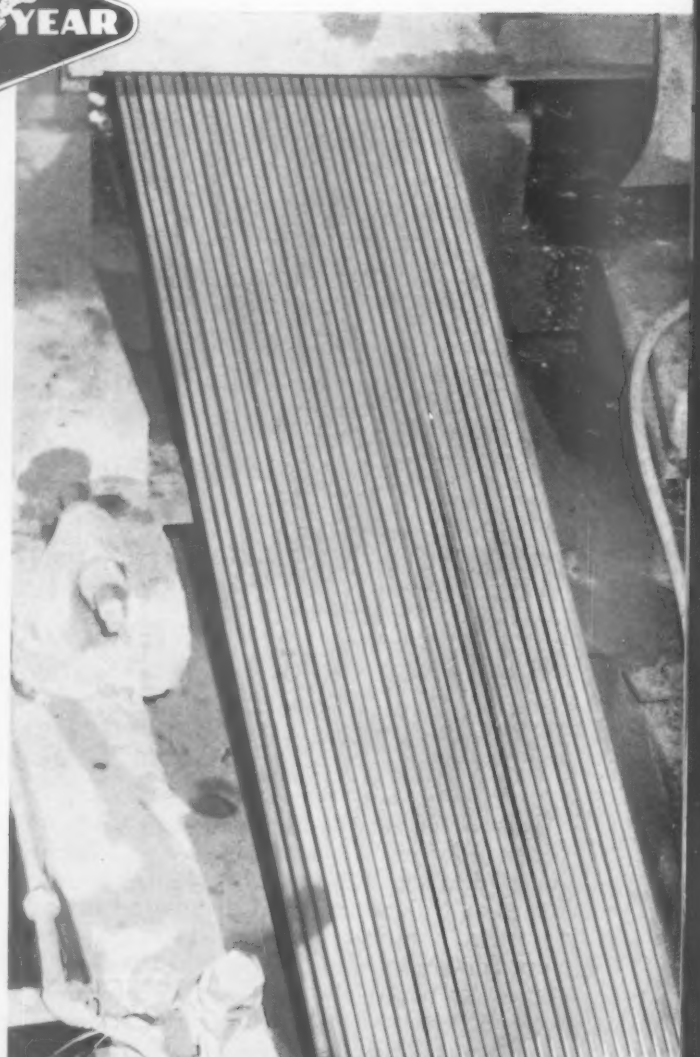
*T.M. Reg. U.S. Pat. Off.

EDWARD STEEL VALVES
another fine product by
ROCKWELL

GOODYEAR EXCLUSIVE! IS YOUR SIGN OF V-

GOODYEAR

Goodyear V-Belts' precision matching comes from this exclusive close-tolerance matching equipment that length-codes each belt to 1/32". Most other belt manufacturers code only to 1/10".



Goodyear V-Belts' precision matching assures standout performance. Example: only 28 COMPASS-V-Steel Belts handle this big steel saw, normally calling for 42 belts. Result: the steel mill saved $500 at the original installation – will save more at every belt change.

THE GREEN SEAL BELTS CODED TO 1/32"

Here's your assurance that every belt in a set matches in length – pulls together for maximum trouble-free horsepower hours

What's more, the Green Seal means –

Dimensional stability that lasts the life of the belt–thanks to shrink- and stretch-resistant "muscles" of 3-T Process Cord or airplane-type steel cable built into each belt.

Satisfactory performance even when subjected to dampness – because of special mildew-inhibited compounds.

The most complete line of V-Belts anywhere today – always within easy reach through a nationwide network of distributor stocks.

The proper selection of V-Belts to meet your requirements with the help of the G.T.M.– Goodyear Technical Man – America's top belting specialist.

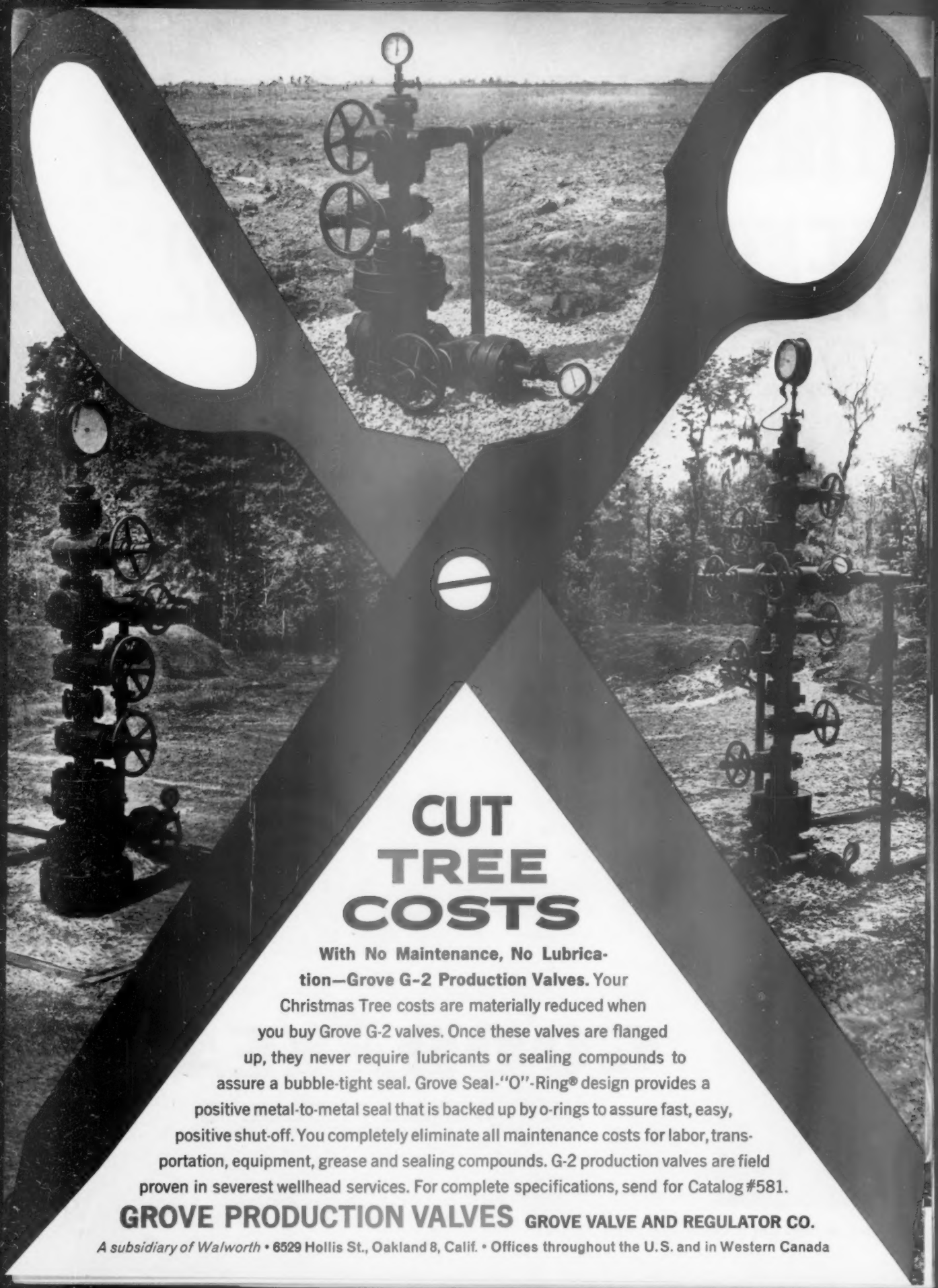
So make the GREEN SEAL your sign of savings–in both time and money–by calling your Goodyear Distributor. Or write Goodyear, Industrial Products Division, Akron 16, Ohio.

Lots of good things come from

GOODYEAR

INDUSTRIAL PRODUCTS

Green Seal, Compass–T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio



CUT TREE COSTS

With No Maintenance, No Lubrication—Grove G-2 Production Valves. Your Christmas Tree costs are materially reduced when you buy Grove G-2 valves. Once these valves are flanged up, they never require lubricants or sealing compounds to assure a bubble-tight seal. Grove Seal-"O"-Ring® design provides a positive metal-to-metal seal that is backed up by o-rings to assure fast, easy, positive shut-off. You completely eliminate all maintenance costs for labor, transportation, equipment, grease and sealing compounds. G-2 production valves are field proven in severest wellhead services. For complete specifications, send for Catalog #581.

GROVE PRODUCTION VALVES **GROVE VALVE AND REGULATOR CO.**

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between maximum performance and moderate cost . . .

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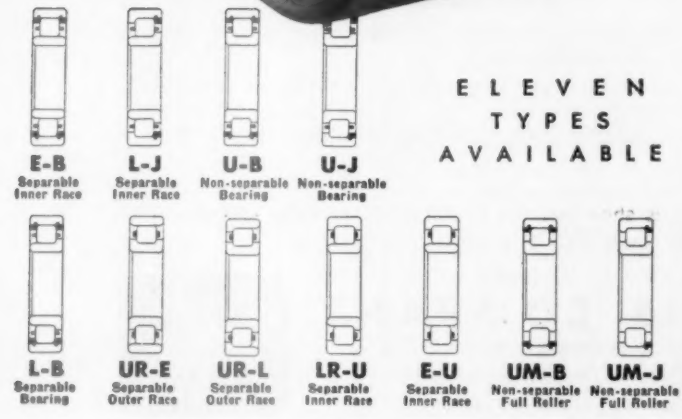
For those hundreds of in-between applications where performance requirements are more exacting than those provided by the ordinary commercial bearing, but where maximum precision would be unneeded precision – specify Tru-Rol for the job.

Tru-Rol Bearings provide above-commercial-grade efficiency . . . at worthwhile savings in cost. Internal clearances are closely controlled. Rollers are equally spaced to eliminate out-of-balance vibration. Each roller is crowned to distribute the load evenly along the full length of the roller. Eleven types available in single and double width bearings, in stamped steel retainer, segmented retainer or full roller construction.



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Ask your nearby Rollway Service Engineer to detail the quality you *should be getting* in your "commercial grade" bearings. Or write for the Rollway Tru-Rol catalog showing the full line, and capacity and size ranges. ROLLWAY BEARING COMPANY, INC., Syracuse, N. Y.

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UPGRADE PRODUCT QUALITY

IMPROVE OPERATING EFFICIENCY

REDUCE MAINTENANCE COSTS

. . . all important goals and a vital part of any plant operating program.

We at Warner Lewis Company believe that our products can contribute substantially to the achievement of these goals in your plant. With the experience and knowledge gained by countless in-plant applications of our water separator/filters we welcome the opportunity to discuss the installation and operation of our equipment with you.

Check this list for just a few of the many applications now serving the industry which might be of help to you:

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_____1. Products to storage: Warner Lewis separator/filters remove essentially all solids and 100% of free or entrained water, even from product treated with corrosion inhibitors forming tight emulsions.

_____2. Caustic treating: Special Warner Lewis coalescing media remove traces of entrained caustic water from treating and washing operations.

_____3. Loading Rack: Warner Lewis separator/filters de-haze finished products, removing water cloud and solids such as catalyst fines. Insurance against costly customer complaint.

IMPROVE OPERATING EFFICIENCY

_____1. Warner Lewis separator/filters remove all free water and solids from process feed stocks, eliminate catalyst dilution.

_____2. Elimination of free water in process streams checks corrosion, cuts costly maintenance in heat exchangers and other process equipment, reduces inhibitor costs.

_____3. Where complete dehydration is used, Warner Lewis separator/filters ahead of desiccant beds, remove all free water and provide longer desiccant life.

REDUCE MAINTENANCE COSTS

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_____2. Efficient filtration eliminates solids build-up in lines, vessels and storage tanks, eliminates costly cleaning operations.

_____3. Warner Lewis separator/filters prevent dilution or fouling of catalyst with water and solids.

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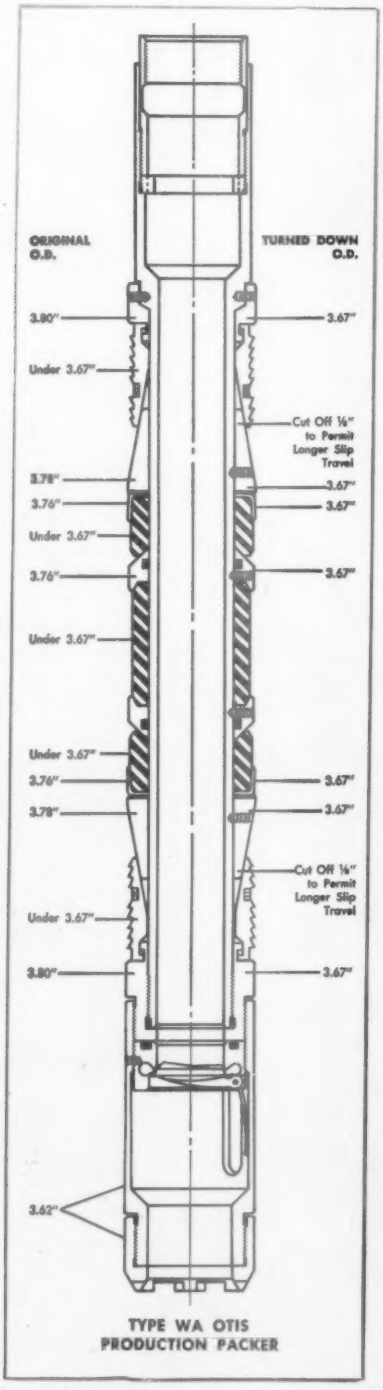
OTIS PRODUCTION NEWS

Volume I, Number 3 **Otis Engineering Corporation • Dallas** *Production Equipment and Services*



TYPE WA OTIS PRODUCTION PACKER

Two Standard Model 4½" Otis Production Packers Turned Down To 3.67" O.D. And Set in 5" Drill Pipe

HOUMA, LA. – Otis packer specialists from the Belle Chasse and Houma divisions recently solved an extremely difficult well completion problem for one of the major producing companies in their area, by turning down and setting two of their standard model 4½-inch Type WA Production Packers between tool joints in stuck 5-inch drill pipe. The fact that these packers could be turned down from their normal 3.80-inches to 3.67-inches and set in 4.30-inch I.D. pipe, saved the operator a considerable amount of rig time in addition to the cost of having special packers designed and built.

Well conditions at the time the Otis specialists were called in were as follows: 12,500 feet of 5-inch, 19.50-pound drill pipe had become stuck in a salt water flow during final drilling operations and could not be freed. As a result, the pipe had been cemented in place at that depth and cut off at 2900 feet, then tied back to the surface with 7-inch, 29-pound casing. The only potential producing interval was located at 11,600 feet. Before attempting to bring in the well, the operator wanted to plug below, and set a packer above, the potential zone.

Probably the most serious problem facing the Otis specialists on this particular job was the fact that the operator wanted the packers set in the pipe between tool joints. This meant any packer run into the well would have to have an outside dimension of less than 3.75-inches to pass through the tool joints, yet have a sufficient range to set and hold in the 4.30-inch I.D. pipe. Although none of the standard production packers or bridge plugs available today are designed to cover this range, the Otis specialists felt confident their packer could be turned down and run. In the interest of time and cost, the operator agreed to try it.

After first running a 3.68-inch O.D. junk basket to 11,800 feet, the first Otis packer, equipped with an expendable sealing unit, was run in to 11,744 feet and set. In that this packer was to serve as the bridge plug, it was set 4 feet below a tool joint so that the cement to follow would straddle the joint and give a stronger plug. Running time was approximately 5¼ hours, due to the viscosity and weight of the drilling mud. Once set, three dump bailer loads of cement were placed on top of the packer and allowed to set for 12 hours. At the end of that time, the plug was tested to 3500 p.s.i. Where fluid had been lost through the bit prior to plugging, there was no bleed down of pressure.

Next, the drill pipe was perforated and squeezed below and above the intended producing interval and the zone itself perforated. With these operations completed, another turned-down Type WA Packer was run and set between tool joints at 11,570-feet. A successful test to 1500 p.s.i. convinced the operator the packer would hold and swabbing operations to bring in the well were begun.

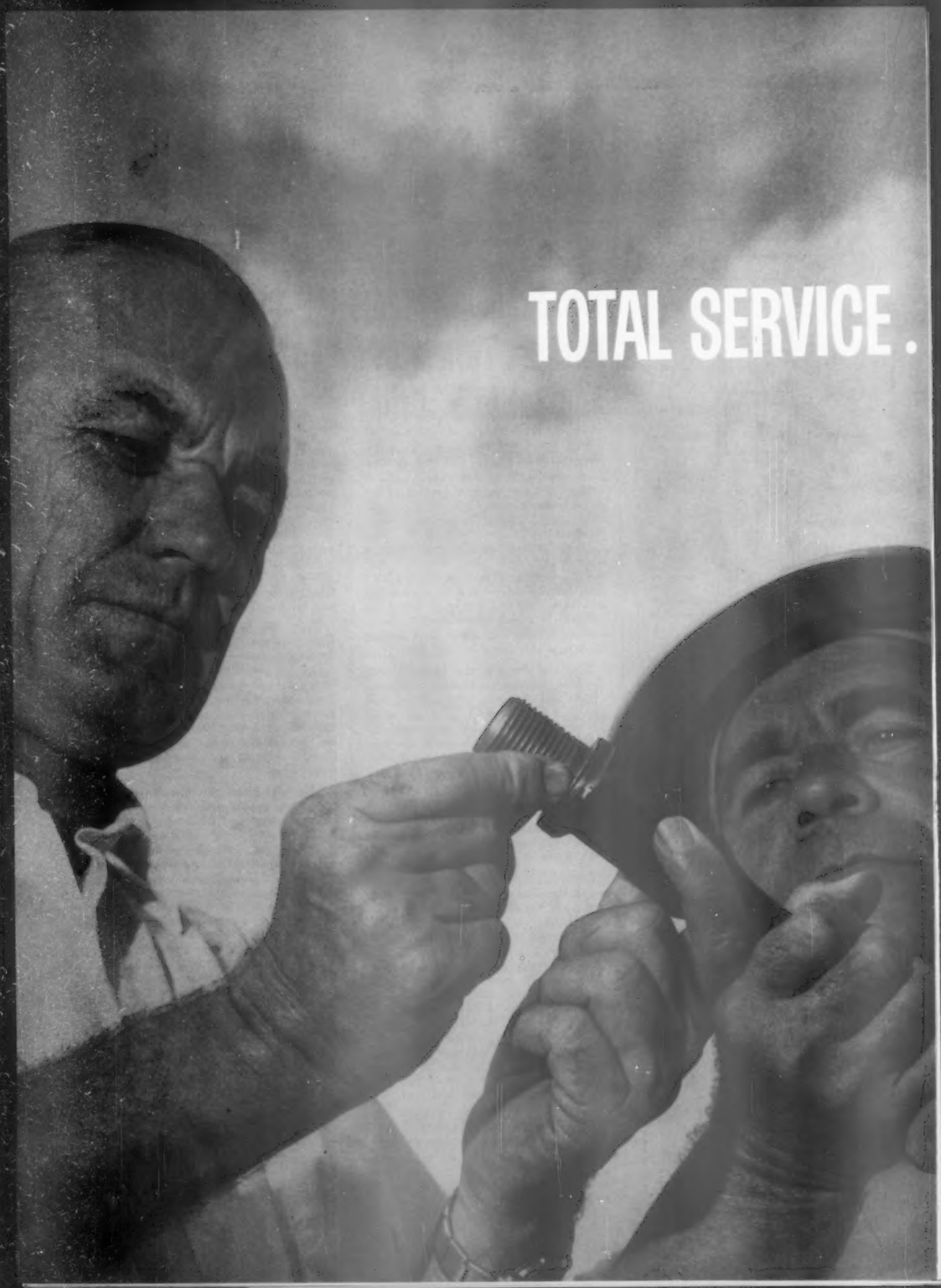
The help given this operator by his local Otis packer and completion specialists is typical of the service available from all Otis field personnel. Their knowledge of production problems and of the application, installation, and capacity of their equipment permits them to make sound, on-the-spot recommendations. The next time you find it necessary to consult with someone regarding packers or well completion techniques, call the Otis office nearest you or write Otis, Department 3-P, Box 35206, Dallas 35, Texas. You'll find experienced Otis well completion specialists ready to help you – anxious to serve you. *© 1960 O. E. C.*

OTIS

Engineering OTIS Corporation

General Offices:

6812 Denton Drive • Dallas, Texas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C21-33-581

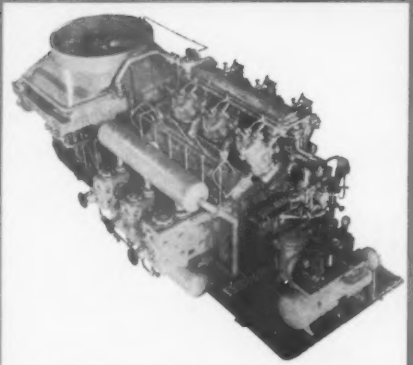
C-B/S Design-Engineered Compressor Plant . . .

Provides Balance and Efficiency For Offshore Gas Boosting, Gas Lift

C-B/Southern designed, engineered and built this 400 horsepower-rated GMXD-6 packaged compressor plant for a Southern Louisiana offshore operation. The problem was to provide a packaged compressor plant with sufficient horsepower rating to handle pressures ranging from 45 psig to 1200 psig, yet so balanced that vibration was negligible since the unit was to be mounted on a submersible 3-tier concrete barge. The natural selection was a C-B/Southern packaged GMXD-6 compressor plant.

The selection was a time-saver, too: while the concrete barge was being constructed in New Orleans the compressor was built in Houston. The compressor and related equipment were installed on the barge in New Orleans, floated to the location. The barge was sunk in place and the compressor connected to the field gas lines.

C-B/Southern and Cooper-Bessemer engineers worked closely with the barge construction people to avoid the possibility of harmful resonant conditions. This is another example of the broad service C-B/Southern offers to provide complete compatibility between the building of packaged compressor plants and operating conditions.



The GMXD-6 was engineered to produce 400 bhp. The GMXD line is also built in horsepower ranges from 265 to 825. C-B/S packaged compressor capability is proved by the 40,000 horsepower the company designed, engineered and built last year. Other packaged compressor plants are available in horsepower ratings from 100 to 1440; unitized compressors, both reciprocating and centrifugal, to 10,500 hp.

CB/S

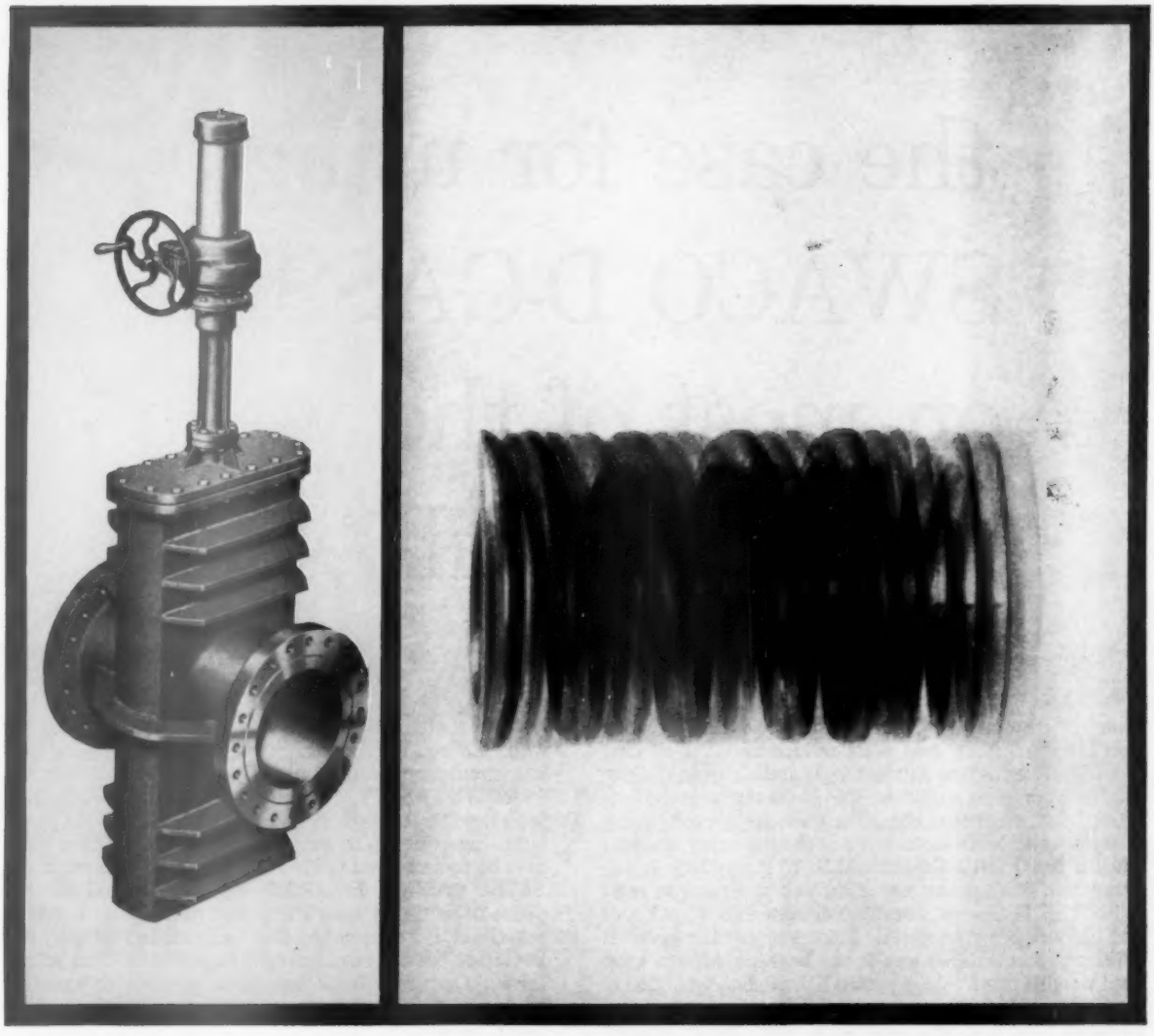
PACKAGED COMPRESSORS

CB/S

C-B/Southern, P. O. Box 19267, Houston 24, Texas • HOmestead 8-5441

A division of The Cooper-Bessemer Corporation

MANUFACTURERS OF PACKAGED COMPRESSOR PLANTS FOR GAS GATHERING, GAS LIFT, GAS INJECTION APPLICATIONS



Crane fabricated pipeline valves with the seal that springs into action.

Mounted in any position, Crane's new 150 and 300 Pound fabricated steel conduit pipeline gate valves deliver smooth, turbulence-free flow, and positive, bubble-tight shutoff. This positive, leakproof closing is due to Crane's unique spring-action, floating seal.

Here's how the seal works: Spring-loaded seat ring plates press seat ring against disc for the primary seal. Line pressure forces disc tightly against downstream seat ring, and achieves a double sealing action by forcing the upstream seat ring against the disc. As an added safety feature, spring control permits excessive pressure in the valve body to bleed off into the line.

Incorporating field tested and proven features developed for Crane's 400 and 600 Pound cast steel full-way conduit-type gate valves – the new Class 150 and 300 fabricated steel valves are first choice for every petroleum and gas pipeline service.

Available 14" to 30" with flanged, butt-welding or flanged-by-welding ends. Catalog Nos. 150 pound–1190TF (flanged), 1191TF (butt-welding); 300 pound–1390TF (flanged), 1391TF (butt-welding). Meet all applicable ASA and API specifications. With handwheel, bevel gear, electric motor or cylinder operator.

For complete details contact your Crane Distributor, or write: Crane Co., Industrial Products Group, Dept. G, 4100 So. Kedzie Ave., Chicago 32, Ill. In Canada: Crane, Ltd., 1170 Beaver Hall Square, Montreal.

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OF HOME AND
INDUSTRY

CRANE

VALVES AND PIPING
ELECTRONIC CONTROLS
PLUMBING
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the case for using a SWACO D-GASSER on most of the wells you drill

Many operators and drilling contractors don't realize how D-Gassers can help them reduce the over-all cost of wells. By removing entrained gas and air from drilling mud after each circulation, the D-Gasser permits improved control of mud characteristics. As a result, many operators can profit from some of the following savings:

SAVES MUD AND CHEMICALS. If gas-cutting is encountered, the chances are good you can save on mud bills. The D-Gasser usually permits drilling without adding weighting material even though the well is "kicking" from drilled gas. It has been possible to keep mud weights more than a pound lighter than would have been possible without the D-Gasser. Over-treatment of mud (and the resulting stuck pipe and formation trouble) can be avoided when the D-Gasser is used. Trip gas and viscosity increases due to dissolved and entrained gas may be controlled without costly and time-consuming mud treatment.

SAVES LOST CIRCULATION MATERIALS. Since the D-Gasser often makes it possible to continue drilling while the well is "kicking", lighter mud can be used and lost circulation problems may be held to a minimum.

PERMITS FASTER, LOWER COST DRILLING. Drilling rates and/or footage per bit may be increased since light, low-solid muds may be used. Total drilling time may be reduced and fewer round trips may be required.

SAVES CASING. Frequently, operators avoid the expense of setting a long string just to evaluate a minor gas show. By eliminating the recirculation of gas, the D-Gasser prevents exaggerated impressions from minor shows. Occasionally, it has been possible to save an intermediate string when a D-Gasser is used.

SAVES WELLS. Many high pressure exploratory wells have actually been saved by the D-Gasser. Costly blowouts, fires and lost holes have been avoided. For full information on how the D-Gasser can help you, contact your nearest SWACO representative or write us direct.

SWACO

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Telephone: EDison 2-4433 Cable Address: "SWACO" Fort Worth

LOUISIANA: New Orleans, Lafayette
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XP-20/Spersene mud systems are so simple, yet they can do what other muds have tried to do for years

In spite of this simplicity, XP-20/Spersene muds are unusually stable under high temperatures and high pressures. They have outstanding filtration characteristics. They retard the natural swelling of solids. They have excellent tolerance for contaminants. XP-20/Spersene muds do what other muds have tried to do for years, and at much less cost.

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SEASON'S GREETINGS

From the Oil Bank of America to oil men around the world: Season's Greetings from all of us at NBT . . . and our sincerest wishes for your progress and prosperity throughout the year ahead. National Bank of Tulsa

NATIONAL BANK OF TULSA

welcomes 1962 as another opportunity for even broader service — as an expression of our faith in the oil industry and in the men who've made OIL a great industry.

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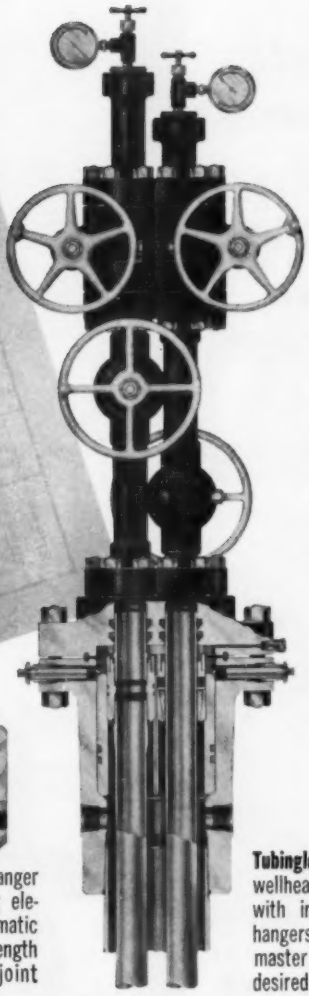
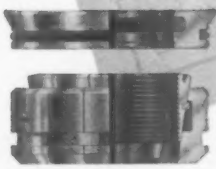
1961 Brought you these NEW O·C·T products



Again this year your needs for new types of wellhead equipment, to use with improved completion techniques, have kept us busy.

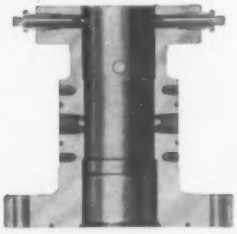
Here are the new designs introduced by O.C.T. during 1961.



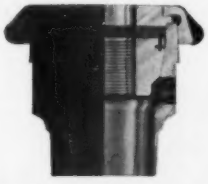
C-21 Casing Hanger — The C-21 consists of slips, slip bowl, and a floating seal ring that provides positive annulus packoff.

C-22 Casing Hanger — This hanger features a single-unit sealing element, slip bowl and slips; automatic seal; and load-carrying strength greater than the pipe's joint strength.

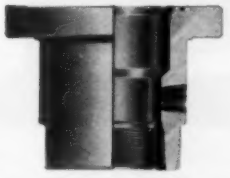
Tubingless Completion Wellheads — These wellheads give you maximum flexibility, with interchangeable slip and threaded hangers, a variety of casing heads, and master bushings to allow assembling any desired single or multiple completion.



T-C Multi-Head — This is a versatile tubing or casing head that accepts 13 different threaded and slip-type hangers for single, dual, or triple completions.



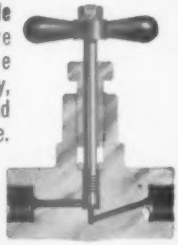
Independent Wellheads — These forged steel, low-pressure casing and tubing heads feature low cost and maximum parts interchangeability.



C-22 Casing Head — A straight-bore casing head designed to support maximum loads and to accept any of three interchangeable hangers.

Type M Tubing Heads — These macaroni tubing heads are designed for hanging 1½-inch and smaller inner tubing strings, especially for tubingless completions. They can be supplied with either flanged or threaded connections.

15,000 psi Needle Valve — This valve has a one-piece forged steel body, Teflon packing, and stainless-steel needle.



Heater Choke — O·C·T's heater choke is designed to give you extra nose length in the heater fluid; acme-thread unions speed installation and removal; many parts are interchangeable with other O·C·T chokes.

O·C·T

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But build it Procon did! Not in 16 months—but in 12 months. Four months ahead of schedule! A modern 12,000 BSD refinery, it includes Platforming®, Unifining®, Merox™, and crude distillation units plus complete supporting facilities.

On stream for Sociedade Nacional de Refinacao de Petroleos (SONAREP) a subsidiary of the Portuguese petroleum marketing firm, Sociedade Nacional de Petroleos (SONAP), this refinery is another tribute to Procon's proven capabilities... to tackle the toughest job ...and complete it in the shortest possible time.

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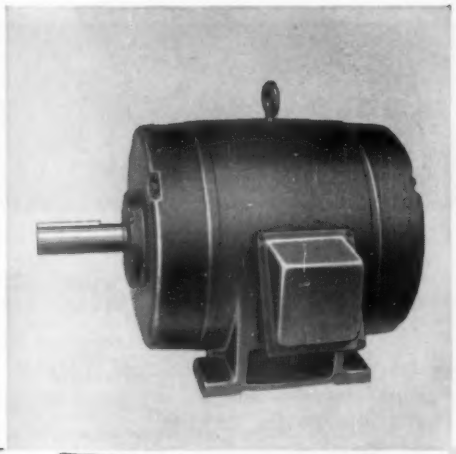
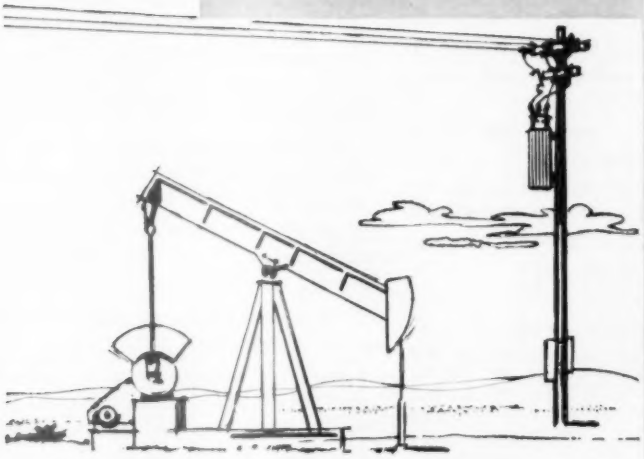


MONEY-SAVING MATES



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Engineering Progress Report

FROM UNION CARBIDE CHEMICALS COMPANY

Ethylene Glycol Scores High As Hydrate Inhibitor

In refrigeration-type gasoline recovery plants, the most widely used hydrate point depressant is diethylene glycol. But, ethylene glycol may offer certain advantages as a replacement in your plant, for example . . .

SELECTION GUIDE

ADVANTAGE	Ethylene Glycol	Diethylene Glycol
Hydrate Inhibition	GOOD	GOOD
Ease of Separation	BETTER	GOOD
Cost	LOWER	—
Vaporization Loss	LOW	LOWER
Solubility Loss	LOWER	LOW

HYDRATE INHIBITION

While both ethylene and diethylene glycol give good hydrate inhibition, with hydrate point depressions generally in the range of 60° to 80°F., reports indicate that ethylene glycol may give a greater depression in those cases needing very low separation temperatures.

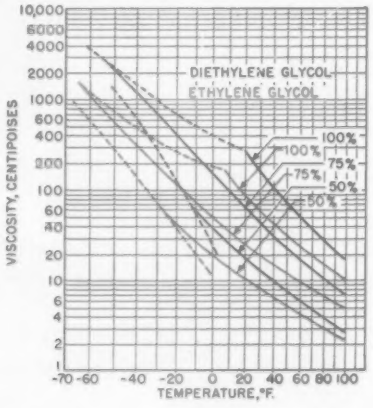
EASE OF SEPARATION

Ethylene glycol-water solutions are easier to separate at very low temperatures than diethylene glycol-water solutions.

This advantage is illustrated in the graph below. At 0°F. the viscosity of a 50 per cent ethylene glycol solution is 20 centipoises, or half the viscosity of the diethylene glycol solution.

An even more marked difference is shown at lower temperatures . . . at—40°C. a 75 per cent ethylene glycol solution has a 300 centipoises viscosity, as compared with 1000 to 2000 for a 75 per cent diethylene glycol solution.

VISCOSITY OF GLYCOL-WATER MIXTURES



COST

Ethylene glycol costs 1¾¢ a pound less than diethylene glycol which means a possible tank car savings of $1,300.

VAPORIZATION

Although ethylene glycol vaporization losses are greater than diethylene glycol's, the difference is insignificant below 30°F., if separator pressure is 750 PSI or higher.

SOLUBILITY

At separation temperatures of 60°F., glycol losses due to solubility should be in the range of 10 to 50 ppm when 50 to 75 per cent ethylene glycol solutions are used; and 20 to 100 ppm with equal strength diethylene glycol.

The higher volatility of ethylene glycol must be taken into consideration in regeneration equipment design and operation; but ethylene glycol may offer advantages in certain systems. Your CARBIDE Technical Representative can show you data on the pros and cons of ethylene or diethylene glycol hydrate inhibition in your system.

For a copy of a new report, "The Glycols as Hydrate Point Depressants in Natural Gas Systems" and a comprehensive bibliography of all the major articles published on gas sweetening and dehydration in the last 25 years, use the coupon.

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☐ Technical data report—"The Glycols as Hydrate Point Depressants in Natural Gas Systems."

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THEY SAY

Texaco's the largest

Dear Sir:

Recently I have had occasion to wager on which of the oil companies is the largest domestic crude producer.

I contend that Texaco is the largest domestic producer and I use as my references: (1) April 1, 1961, issue of Forbes magazine; (2) September issue of Fortune magazine; and (3) Mid-May 1961-62 issue of National Petroleum News "Fact Book."

The person with whom I have this wager will not accept these sources and refuses to accept any source other than yourselves. Will you please clear up this question for us?

Morris L. Estess
Durango, Colo.

We don't like to see such a strong Journal supporter lose a bet, but Texaco is the largest producer of domestic crude. Texaco's 1960 annual report gives its net crude and natural-gas liquids production in the United States as 475,887 bbl. daily. The comparable figure in the Standard Oil (N. J.) report is 439,000 bbl. daily. Texaco overtook Jersey as the nation's largest crude producer in 1959.—Ed.

Trim yes, shearing no

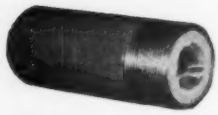
Dear Sir:

Congratulations and many thanks to Frank Gardner for the illuminating and thought-provoking article on our AAPG Bulletin (OGJ, Nov. 27, p. 139).

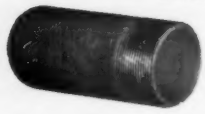
AIME found the same thing happening to their publication 20 years ago when the chemists, metallurgists, and beneficiators began to publish their ideas on mineral separation. The mining man did not always enjoy or appreciate this material, but it did help the industry!

Most of our oil industry geologists of today are much like the mining man—busy applying old ideas to new situations or surroundings. Fortunately, however, our oil industry has enjoyed the foresight and extra money it takes to establish research divisions. Even the smaller

production and maintenance problems solved with Inhibited Acid



BEFORE CLEANING



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Dowell inhibited hydrochloric acid is an efficient, economical solvent and cleaning solution. It is low in cost when its cleaning capacity is considered. One hundred gallons of 15 per cent hydrochloric acid will dissolve up to 184 pounds (one cubic foot) of pure limestone or calcium carbonate. It is ideally-suited to do-it-yourself operations.

Dowell hydrochloric acid has many uses. Some of them are: to improve production from old dolomitic or limestone wells; to remove scale and "gyp" from the face of producing formations, tubing and lead lines; to clean disposal or input wells; and to descale engine cooling systems, heat exchangers, boilers, valves, fittings, nipples, etc.

Dowell inhibited hydrochloric acid is available in small or large quantities from any Dowell station. Ask a Dowell representative for application information.

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companies have their "new idea departments."

It is these new ideas—many of them resulting in, and coming from the study of, the published works of the research man—"that hefty 15% in 1960-1961" as mentioned by Dr. Gardner—which keep our industry growing at a rapid pace.

For the member who said, "I don't see much oil hunting in the Bulletin anymore," let us remind him that a paper by USGS personnel in our current November, 1961, issue on "Correlations of the Tertiary in Alaska," can help us find new oil. On the other hand, the results of recent drilling in Bolivia better belong, and let us hope will continue to be well written up in The Oil and Gas Journal (Nov. 27, p. 79).

Let us caution our fledgling AAPG member who said our Bulletin "needs a haircut" that we can and do periodically get a trim—our publication committees change constantly. However, a real "haircut" may not do the strongest searching group in the world any more good than it did Samson years ago.

Arnold Buzzalini
Skelly Oil Co.
Tulsa

Letters to They Say should be addressed to The Editor, The Oil and Gas Journal, Box 1260, Tulsa, Okla.

CALENDAR

JANUARY

7-10 Pipe Line Contractors Association, annual convention, Boca Raton Hotel and Club, Boca Raton, Fla.

8-12 Society of Automotive Engineers, annual meeting, Cobo Hall, Detroit.

16-18 Kentucky Petroleum Marketers Association, annual meeting and convention, Brown Hotel, Louisville, Ky.

17-19 National Association of Corrosion Engineers, Canadian region eastern division conference, King Edward Hotel, Toronto.

19 Natural Gas Processors Association, Gulf Coast regional meeting, Robert Driscoll Hotel, Corpus Christi, Tex.

24-26 American Society of Mechanical Engineers, second symposium on thermophysical properties, Princeton University, Princeton, N. J.

24-26 Texas A&M College, symposium on instrumentation for the process industries, Memorial Student Center, College Station.

31-Feb. 1 National Petroleum Refiners Association, Gulf Coast regional meeting, Ben Milam Hotel, Houston.

FEBRUARY

1-3 American Law Institute, American Bar Association, joint committee on continuing legal education, forum on

. . . one of a series presented by Western Supply Company, Tulsa, to improve the "I. Q."* of engineers . . . (*"Income Quotient")

TRAIN YOURSELF AND OTHERS IN SUPERVISORY TECHNIQUES FOR PROFESSIONAL ADVANCEMENT

Popular thinking on any subject is often like a pendulum, swinging forward in sheer exhilaration over an exciting idea, then backward to a cynical attitude against it. Years ago, health columnists extolled the nutritive qualities of spinach. Shortly thereafter, it was equally popular to decry spinach as an over-glamorized weed.

This vacillation springs from the efforts of spokesmen to capture interest, and the tendency of many people, like wild creatures in the forest, to give attention to whatever is moving regardless of the direction. That is why it sometimes seems that the more preposterous an idea the more credence it receives.

After World War II, supervisor and management development became extremely popular. Some of these programs naturally fell short of expectations, and there are always detractors — ready to display their intellectual brilliance by speaking cynically of *all* types of human relations training. Real progress in supervisory methods has, therefore, been slow.

Supervisory personnel, continually aware of the intrinsic values of human relations, are the key to uninterrupted production, completion of projects successfully and on time, for they forge the links in the productive chain solidly together.

Your management is interested not only in the creative, bold steps you would take into unknown solutions to problems, but also in how quickly and productively (profitably) you can put these ideas into practical application. When the solution, or idea, leaves your desk and starts down the long line of being put into practice, the supervisors throughout that chain of action will determine to a great extent whether their individual components will function properly or whether a project will bog down under the weight of misunderstanding and apathy.

It is extremely important, therefore, to maintain good supervisory practices throughout the various departments through which the original concept must be translated. It means a thorough understanding of human relations yourself, and the ability to communicate this understanding and appreciation to the supervisory personnel under you. This can and probably must be done both by individual contact with your supervisors and/or by conducting actual courses of study on the subject.

FOOTNOTE: the foregoing paragraphs are a direct quotation from another of Western's "personal-professional development" series, Booklet E-7, titled "Supervision — for Professional Advancement" a copy of which is yours upon request, without obligation. Write to WESTERN SUPPLY COMPANY, HEAT EXCHANGER DIVISION, P. O. Box 1888, Tulsa, Okla. — **where supervision contributes greatly to the manufacture of heat exchangers of the highest quality, and where personal attention to detail is our watchword.**

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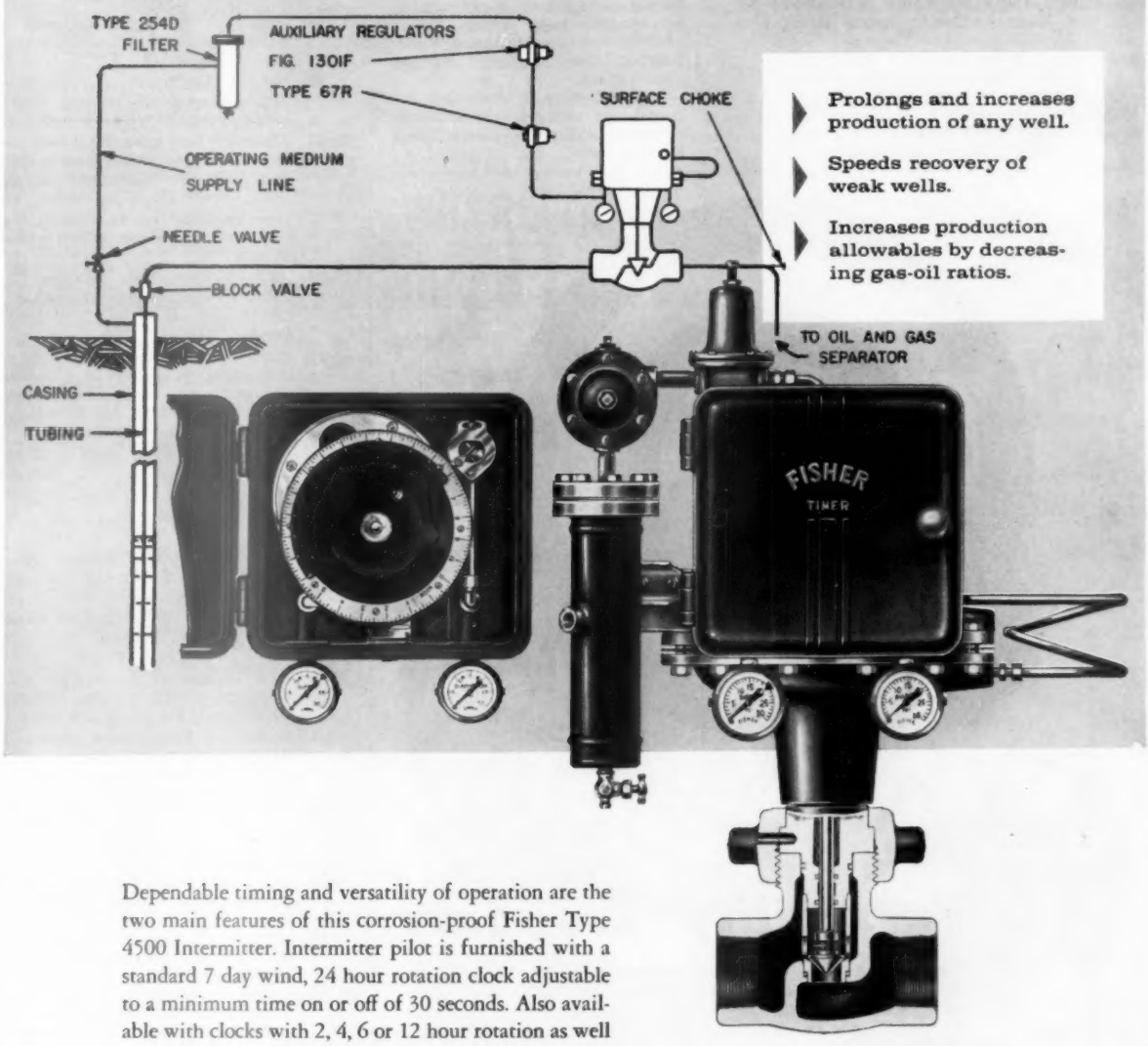

- Prolongs and increases production of any well.
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- Increases production allowables by decreasing gas-oil ratios.

Dependable timing and versatility of operation are the two main features of this corrosion-proof Fisher Type 4500 Intermitter. Intermitter pilot is furnished with a standard 7 day wind, 24 hour rotation clock adjustable to a minimum time on or off of 30 seconds. Also available with clocks with 2, 4, 6 or 12 hour rotation as well as clocks with electric drive. Reverse action can be easily achieved by simply rotating relay cap 180°. Complete information is available on the Fisher Type 4500 Intermitter by requesting Bulletin O-4500.

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electronic computers, Statler-Hilton Hotel, Los Angeles.

4-7 American Institute of Chemical Engineers, national meeting, Statler Hotel, Los Angeles.

12-13 Missouri Oil Jobbers Association annual convention and trade exhibit, Hotel Chase, St. Louis.

14-16 Southwestern Legal Foundation, annual institute on the law of oil, gas, and taxation, Southwestern Legal Center, Dallas.

14-17 Pipe Line Contractors Association of Canada, Castle Harbor Hotel, Bermuda.

16 Natural Gas Processors Association, South Louisiana regional meeting, Lafayette Petroleum Club, Lafayette.

18-22 American Institute of Mining, Metallurgical, and Petroleum Engineers, annual meeting, New York City.

22 Chemical Institute of Canada, protective coatings division, Seaway Hotel, Toronto.

23 Chemical Institute of Canada, protective coatings division, Windsor Hotel, Montreal.

28-Mar. 2 American Petroleum Institute, Division of Production, southern district meeting, Rice Hotel, Houston.

MARCH

1-2 Southwestern Legal Foundation, conference on economics of gas industry, Southwestern Legal Center, Dallas.

2 Ohio Oil and Gas Association, winter meeting, Deshler Hilton Hotel, Columbus, Ohio.

4-8 American Society of Mechanical Engineers, gas turbine-process industries conference, Shamrock Hilton Hotel, Houston.

6-7 National Petroleum Refiners Association, eastern regional meeting, Sheraton-Cleveland Hotel, Cleveland.

13-15 Symposium on Application of Statistics and Computers to Fuels and Lubricants Research Programs, sponsored by research branch, office of the chief of ordnance, Department of the Army, Granada Hotel, San Antonio.

15-16 Society of Exploration Geophysicists, annual midwestern meeting, Hotel Texas, Fort Worth.

15-16 Society of Petroleum Engineers of AIME, economics and valuation symposium, Dallas.

16 Natural Gas Processors Association, Oklahoma regional meeting, Sheraton-Oklahoma Hotel, Oklahoma City.

19-22 Kentucky Petroleum Marketers Association, management institute conducted by the University of Louisville, Brown Hotel, Louisville, Ky.

21-23 New England Gas Association, annual meeting, Statler-Hilton Hotel, Boston.

21-23 American Petroleum Institute, Division of Production, southwestern district meeting, Lincoln Hotel, Odessa, Tex.

27-29 American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, joint annual meeting, Fairmont Hotel, Civic Auditorium, San Francisco.

27-29 American Society of Mechanical Engineers, power conference, Sherman Hotel, Chicago.

APRIL

2-4 National Petroleum Refiners Association, annual meeting, Granada Hotel, San Antonio.

3 Chemical Institute of Canada, chemical economics division conference, Royal York Hotel, Toronto.

4-6 API, Division of Production, Mid-Continent district meeting, Sheraton Oklahoma Hotel, Oklahoma City.

5-6 Society of Petroleum Engineers of AIME, upper Gulf Coast region, drilling and production practices conference, Beaumont, Tex.

9-10 Instrument Society of America, national chemical and petroleum instrumentation symposium, Wilmington, Del.

9-11 Mid-West Gas Association, annual meeting, Hotel Radisson, Minneapolis.

9-12 National Oil Fuel Institute, national oil heat and air conditioning exposition, Chicago.

11-12 Petroleum Industry Electrical Association and Petroleum Electric Supply Association, convention and exposition, Dallas.

11-13 API, Division of Production, Rocky Mountain district meeting, Hilton Hotel, Denver.

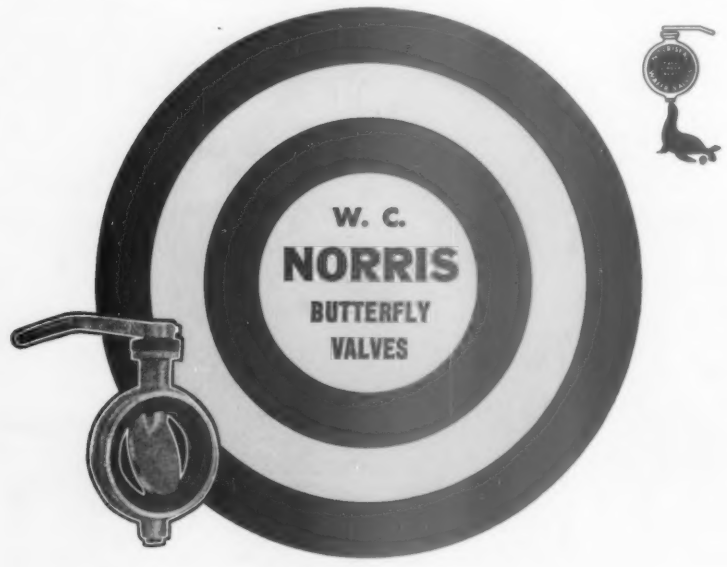
12-13 Society of Petroleum Engineers of AIME, new petroleum production and reservoir engineering developments, Mayo Hotel, Tulsa.

14-18 Petroleum Equipment Suppliers Association, annual meeting, Boca Raton Hotel, Boca Raton, Fla.

15-19 American Society of Mechanical Engineers, oil and gas power division conference, Shoreham Hotel, Washington.

17 Society of Plastics Engineers, Philadelphia section, regional technical conference, Sheraton Hotel, Philadelphia.

17-19 Southwestern Gas Measurement Short



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17-19 American Society for Metals, regional conference and exhibition, materials and materials processing for the petroleum, petrochemical and chemical industries, Shamrock-Hilton Hotel, Houston.

23-25 American Association of Petroleum Geologists, Rocky Mountain section annual meeting, Salt Lake City.

24-26 American Society of Mechanical Engineers, production engineering conference, Van Curler Hotel, Schenectady, N. Y.

25-27 Natural Gas Processors Association annual convention, Hilton Hotel, Denver.

29-May 1 Independent Petroleum Association of America, midyear meeting, Hotel Muehlebach, Kansas City.

29-May 1 Empire State Petroleum Association, spring convention, Statler-Hilton Hotel, Buffalo, N. Y.

29-May 2 Liquefied Petroleum Gas Association, annual convention and trade show, Conrad Hilton Hotel, Chicago.

30-May 2 Southern Gas Association, annual meeting, and American Gas Association, transmission conference, Rice Hotel, Houston.

30-May 2 API, Division of Transportation, annual tanker conference, Del Monte Lodge, Pebble Beach, Calif.

MAY

2-4 API, Division of Finance and Accounting, midyear meeting, Americana Hotel, Bal Harbor, Fla.

4 Chemical Institute of Canada, rubber chemistry division, Niagara Falls, Ont.

7-8 Society of Petroleum Engineers of AIME, North Texas section, fifth biennial secondary recovery symposium, Wichita Falls, Tex.

7-8 American Society of Mechanical Engineers, maintenance and plant engineering conference, Royal Orleans Hotel, New Orleans.

10-11 API Division of Production, Pacific Coast district meeting, Biltmore Hotel, Los Angeles.

11 Natural Gas Processors Association, Permian Basin regional meeting, Lincoln Hotel, Odessa, Tex.

11-12 Kansas Independent Oil and Gas Association, annual meeting, Broadview Hotel, Wichita.

14-17 API, Division of Refining, midyear meeting, Fairmont and Mark Hopkins hotels, San Francisco.

16-18 API, Division of Production, eastern district meeting, Deshler Hilton Hotel, Columbus, Ohio.

17-18 Society of Petroleum Engineers of AIME, production automation meeting, Hobbs, N. M.

20-23 American Institute of Chemical Engineers, national meeting, Lord Baltimore Hotel, Baltimore.

22-23 National Petroleum Refiners Association, computer conference, Ben Milam Hotel, Houston.

22-25 API, Division of Marketing, midyear meeting, Queen Elizabeth Hotel, Montreal.

23-25 API, Division of Transportation, annual pipeline conference, Denver Hilton Hotel, Denver.

23-25 Eleventh National Telemetering Conference, Sheraton-Park Hotel, Washington.

24-25 AIME, Rocky Mountain petroleum sections, annual joint meeting, Billings, Mont.

27-30 Chemical Institute of Canada, Canadian chemical conference and exhibition, Macdonald Hotel, Edmonton.

JUNE

4-6 American Society of Mechanical Engineers, lubrication symposium, Deauville Hotel, Miami Beach.

5-7 American Society of Mechanical Engineers, fuels symposium, Rutgers University, New Brunswick, N. J.

10-15 American Society of Mechanical Engineers, summer annual meeting, Chateau Frontenac, Quebec.

13-14 National Petroleum Refiners Association, Mid-Continent regional meeting, Lassen Hotel, Wichita.

20-23 Canadian Gas Association, annual meeting, Manoir Richelieu, Murray Bay, Que.

24-29 American Society for Testing Materials, annual meeting and exhibit, Hotel Statler, New York.

25-26 Michigan Gas Association, annual meeting, Grand Hotel, Mackinac Island, Mich.

25-27 American Association of Cost Engineers, national meeting, Edgewater Beach Hotel, Chicago.

27-29 Automatic Control Conference, sponsored by Instrument Society of America, American Institute of Chemical Engineers, American Institute of Electrical Engineers, American Society of Mechanical Engineers, and Institute of Radio Engineers, New York University, New York.

AUGUST

5-3 American Institute of Chemical Engineers, American Society of Mechanical Engineers, national conference on heat transfer, Shamrock Hilton Hotel, Houston.

20-24 Asphalt Institute, international conference on structural design of asphalt pavements, University of Michigan, Ann Arbor, Mich.

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THE JOURNAL SAID

50 years ago

December 21, 1911

South Penn Oil Co. becomes the buyer of Pennsylvania-grade crude following abolition of long-established and industry-famous Seep Purchasing Agency. Joseph Seep made president of South Penn. Business of Seep's agency in other areas is taken over by various buying agencies.

Midwest Oil Co. starts oil runs through its newly completed 55-mile pipeline from the Salt Creek fields to storage at Casper, Wyo., where it is building an entirely new refinery. When the refinery is running full blast, active development at Salt Creek can be expected.

An American consulate in the Far East reports American interests have obtained a large and valuable oil concession in northern China and are in the market for an estimated $3,000,000 worth of pipe, equipment, and other materials preparatory to starting development. Name and address of the interests, available from the consulate, have been withheld from general release to avoid a rush of salesmen.

25 years ago

December 17, 1936

Byrd-Frost, Inc., of Dallas, has purchased extensive acreage in the large Talco field of East Texas, and in conjunction with Lucy Petroleum Co. will build a 5,000-bbl. refinery at nearby Mount Pleasant. With this acreage, totaling 2,620 acres, and the 858 acres already held, Byrd-Frost, Inc., is the second-largest lease holder and producer, next to Humble Oil & Refining Co., in the field.

Sun Oil Co. consolidates and absorbs all its subsidiaries, including Twin State Oil Co., and will operate them under the parent name.

A wildcat in the Oklahoma Panhandle is giving indication of opening first production in that part of the state. Allison & Barnhill's 1 Bingley, in Texas County, flowed 2 M.M.c.f.d. of gas in sands from 2,611 ft. to total depth of 2,750 ft.

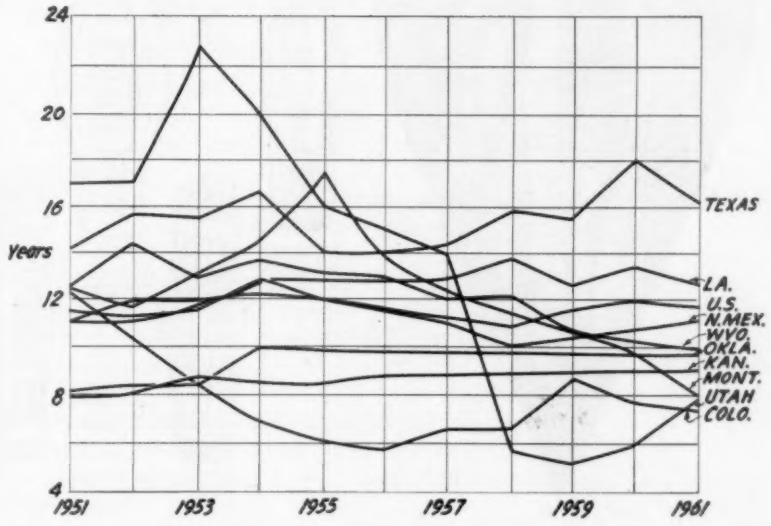
10 years ago

December 20, 1951

First oil well in State of Washington is completed near Ocean City, Grays Harbor County. Discovery well, Tom Hawksworth Oil & Gas Development Co. 4 Hawksworth-State, flows 35 bbl. of 49°-gravity oil with 300 M.c.f.d. of gas from a Miocene zone at 3,714 ft.

Pennsylvania's deepest test, California Co.'s 1 Bennett, a wildcat near La Porte, in Sullivan County, is completed as a dry hole at total depth of 12,343 ft.

JOURNALLY SPEAKING



Can of worms

IF THIS CHART looks like a can of worms, that's exactly what Editor George Weber called it when he used it as a slide in a speech to the Utah Petroleum Council.

And a can of worms is what the Interstate Oil Compact Commission found it had opened with its study of "equality of opportunity to produce."

The chart shows oil production of certain states divided into their crude reserves and plotted by years—sometimes called the reserves life index.

This is one yardstick suggested for measuring a state's "fair share." But, as you can see, it's a pretty wavy yardstick. And the row among the states over whether to complicate it more by adding natural gas and gas liquids was a nasty can of worms for the IOCC.

Furthermore, the reserves - production ratio is only one of many factors that should be considered in judging the "equality of opportunity" in one state vis-a-vis another.

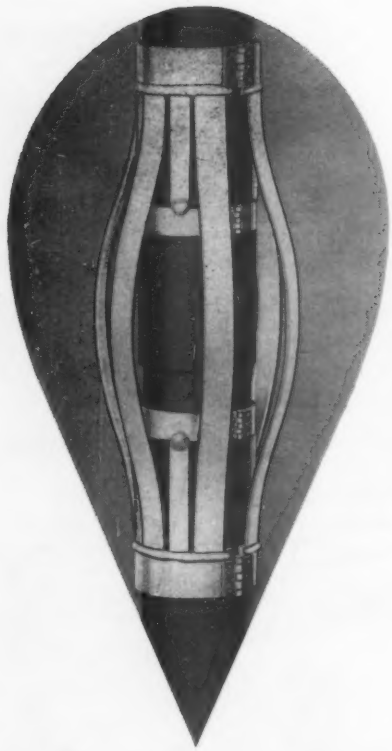
These other factors might include such things as MER, shut-in producing capacity, number of wells, number of productive acres, well spacing, number of stripper wells, extent of unit operations, depth of pays, access to markets, historical relationships, purchaser preferences, and even the relative onerousness of state taxes and conservation regulations.

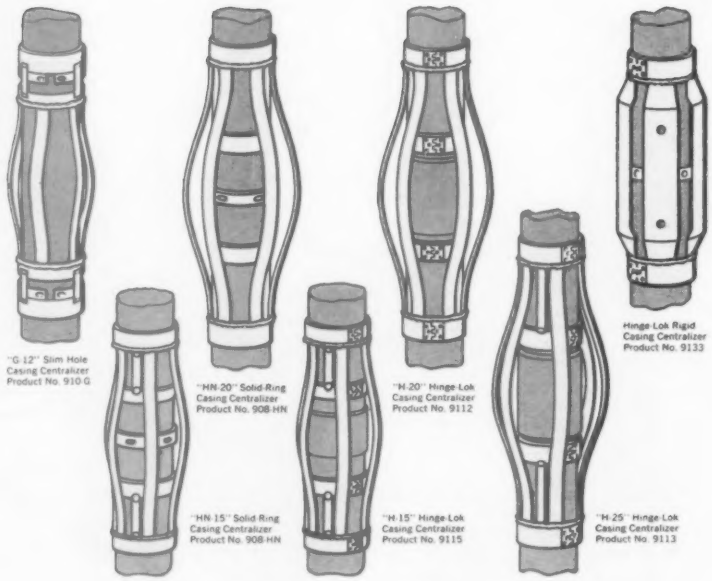
With the prospect that its member states would acrimoniously argue all such things, it is little wonder that the IOCC executive committee clamped the lid back on the can of worms by decreeing that it, itself, will conduct a very limited factual study.

In his Utah speech George Weber didn't attempt to arrive at any formula for a state's fair share of the market. He simply pointed out some of the difficulties the problem presents.

His material is now being worked into an article which will appear in an early issue of the Journal and which should throw considerable light on some of the worms in the "equal opportunity" idea.

—Henry D. Ralph




"G-12" Slim Hole Casing Centralizer Product No. 910-G
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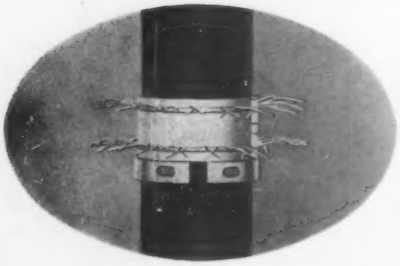
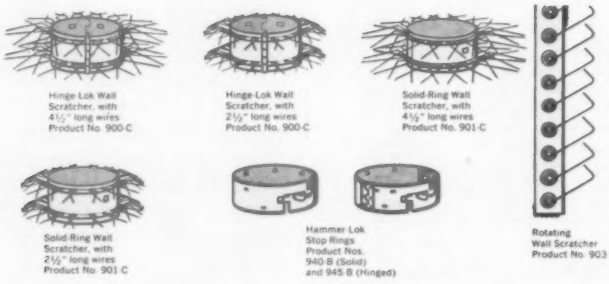
A good cement job starts with two things

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JFK's world trade ideas imply a new oil policy

THE OIL-IMPORTS control program is in deep trouble. President Kennedy's announcement that the Office of Emergency Planning will make a reappraisal of it was ominous. His subsequent speeches on trade policy place it in greater jeopardy.

He said the Trade Agreements Act, on which the oil program rests, is totally irrelevant to today's conditions and should be replaced with a bold new instrument of trade policy.

Apparently the administration's aim is to dovetail U. S. oil imports into a grand design for coping with the fast-developing European Common Market, advancing the incipient Alliance for Progress in South America, and combating the spread of Russian exports.

RESTRAINT ON OIL IMPORTS, to some degree and by some means, is absolutely essential to national security and the welfare of the domestic industry. This has been well established by competent official studies and is accepted by the entire industry.

The President has not denied this, but its importance could get submerged in the welter of argument over broad trade policies and in the infighting over details of new approaches for dealing with oil imports.

A new approach will certainly be sought. The President's words leave no doubt about it. He says tariffs and trade restrictions should not serve local economic interests but high national policy, and hints at tying them in with tax measures and economic planning to co-ordinate the development of the U. S. and its allies and trading partners.

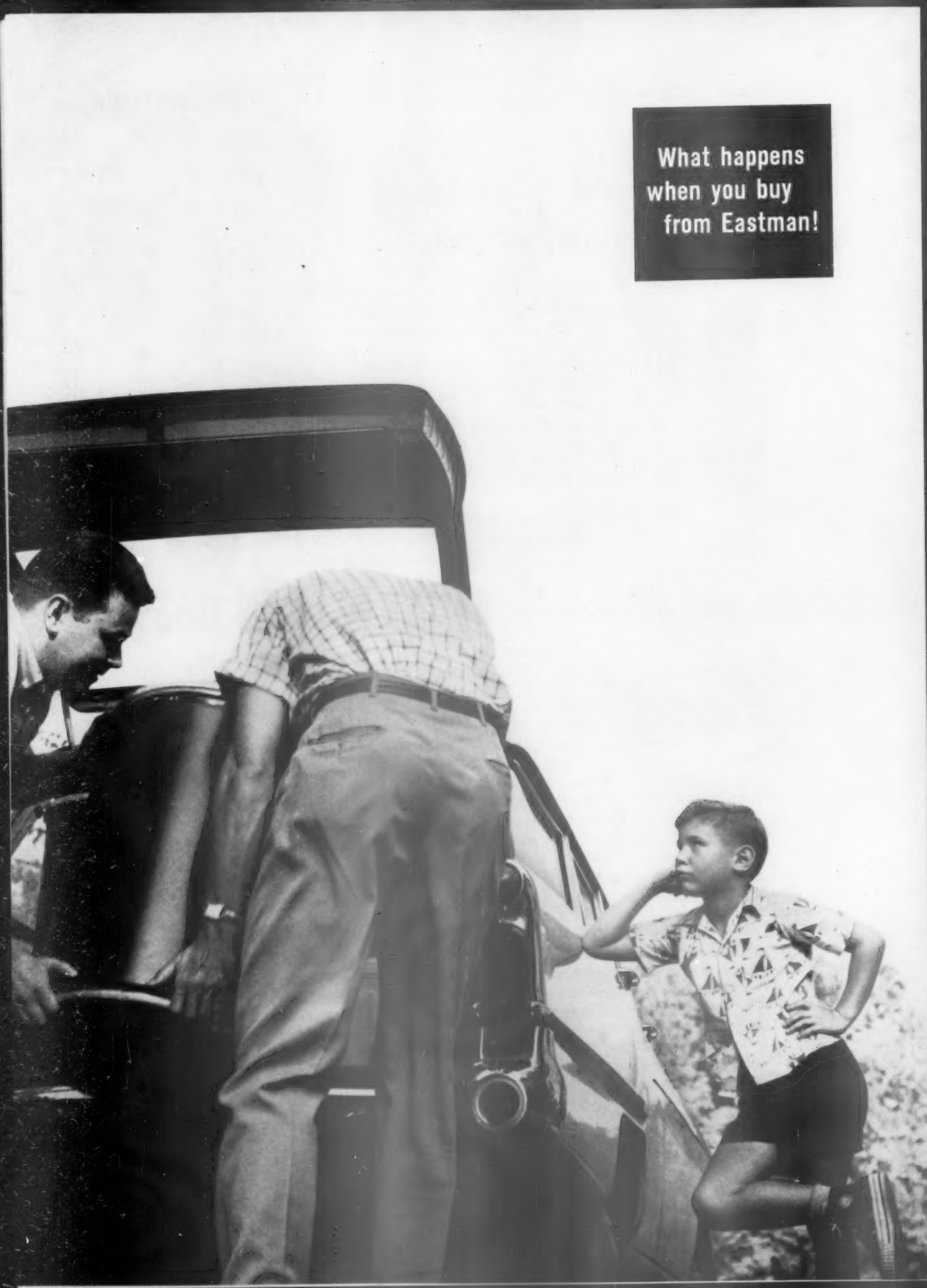
He talks about cushioning adjustments instead of cutting off competition, substituting progress for injury, and maintaining a healthy pressure on producers to improve efficiency. Elsewhere there are hints of an international petroleum agreement, or of subsidies or tax benefits for domestic producers, as a substitute for the quota system.

The industry should note particularly Kennedy's repeated insistence that U. S. business must become competitive with foreign. The implications here could jar the roots of many oil operations, particularly state conservation regulations.

IN VIEW OF ALL THIS, U. S. producers and refiners should prepare for severe shocks if, indeed, a new policy on international oil commerce does emerge from the forthcoming deliberations by Congress.

Argument over revisions in the present quota system may be academic. Far transcending them is the need for united industry action to maintain the principle that control of oil imports is essential to national security.

But beyond this, the domestic industry must look more seriously than ever before at things that make U. S. crude cost more than foreign oil, and take steps to narrow the differential. Its claim on future protection from imports may rest on its showing of maximum efficiency.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"A customer of mine had unexpectedly run out of Tenamene 3 gasoline additive (2,6-ditertiary butyl-p-cresol). Their purchasing agent traced me to the doctor's office, explaining that a back order for this material from another supplier had not arrived as scheduled, and that they urgently needed the additive for process operations already in progress. So I agreed to meet him at our warehouse, fortunately only about ten minutes away.

"When I arrived, the purchasing agent was already there, backing his station wagon, tail-gate down, up to the loading platform. I opened up the warehouse and using a hand truck moved out two drums of Tenamene 3, then helped the P.A. wrestle the drums into the back of his station wagon.

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A di-sec-butyl-p-phenylenediamine. Versatile gum inhibitor for motor fuels and aviation gasoline. Also acts as a sweetening agent in many catalytically cracked stocks.

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A powerful copper deactivator.

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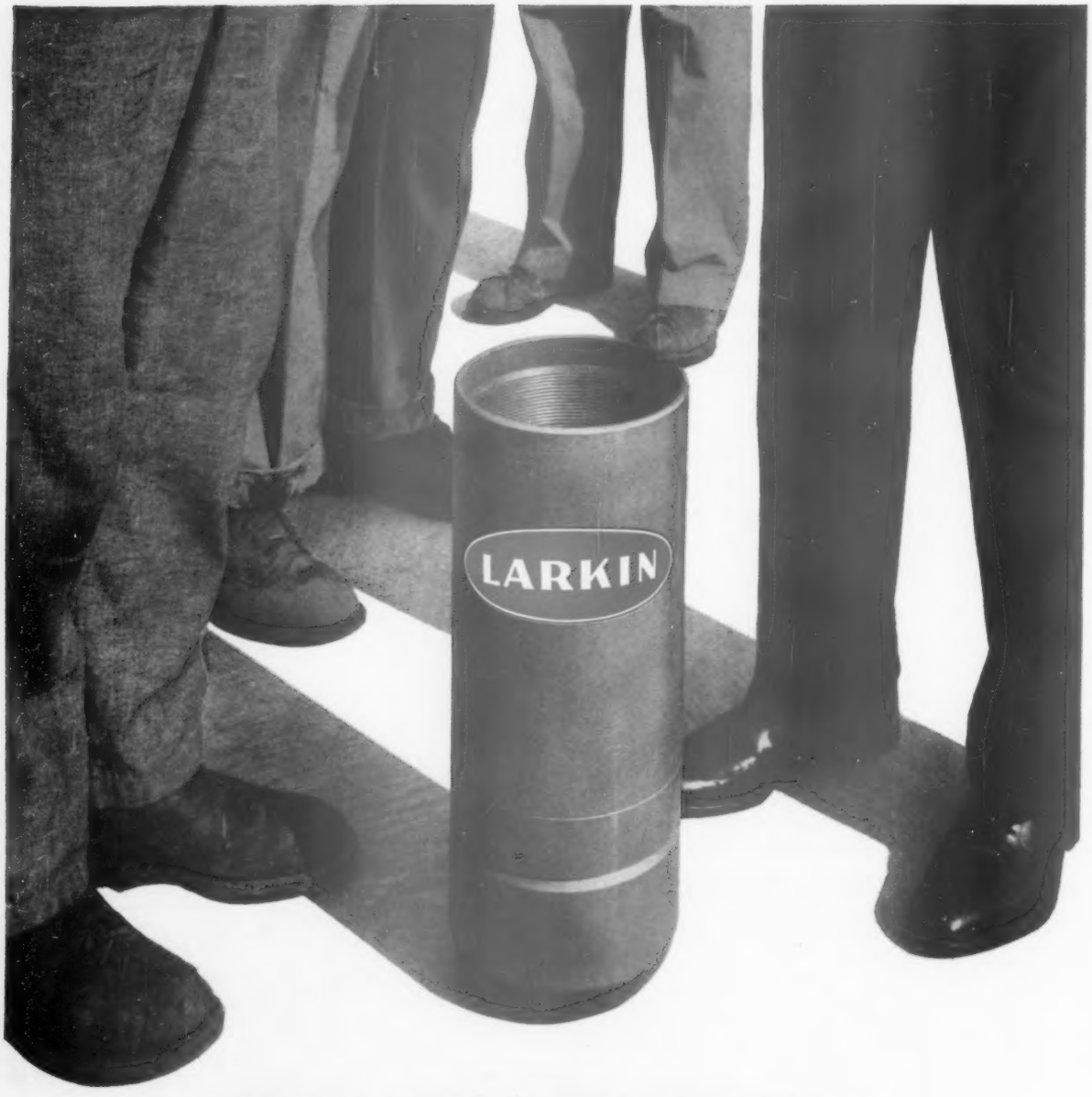

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More import control, or none at all?

The whole future of imports is now in doubt, and it may stay that way for months to come. When a decision finally is made, politics may rival national security as an influence. One thing certain: oil won't be considered alone.

Clyde La Motte
Washington Editor

ALMOST anything can happen to oil import controls, now that the administration has turned its attention to the problem.

Conceivably, controls on crude oil or residual fuel oil—or both—could be eliminated.

Or they could be tightened.

It is likely that the eventual solution will be between these extremes. Just where, however, is the question that is causing the industry a great deal of uncertainty.

This uncertainty is accompanied by some fear that the administration's decision may not rest on the merits or demerits of the case but on a number of other factors, including politics.

One thing does appear certain: oil's problems will not be considered alone but in conjunction with other broad policies and plans.

This seems evident from the fact that the Department of Interior's proposals were rejected and the issue transferred to an interdepartmental committee headed by the Office of Emergency Planning.

Interior had made a lengthy study and had arrived at the conclusion that the domestic producing industry was in need of more help.

No one in the administration has challenged this need—at least not publicly—but some department officials apparently convinced the White House that there was a great deal more involved than just the health of the domestic industry.

This attitude was apparent in a passage of the White House statement which read: "The study will take into account not only the welfare of the domestic petroleum industries but also the need to promote the nation's economic growth in the face of rapid technological and world changes."

National security. Up to this point, there has been no outright challenge of the previous administration's findings that a national security need existed for crude-oil import controls. However, there appears to be a wide range of views in government as to the extent of this need and what the best means is for meeting it.

Note that the White House statement directed OEP to make a recommendation on "alternate means of achieving our security objectives."

Just what other factors will be taken into consideration during the study seemingly has not been decided, but they apparently will cover a wide range, including international policies, tax treatment, etc.

Also, it is a good guess that the administration's general move to liberalize trade restrictions will have considerable impact.

Reciprocal trade. The administration is saying that a mere extension of the present Trade Agreements Act is not enough, that a major overhaul is necessary to give the President broad powers to negotiate tariff cuts on a broad scale rather than by the tedious, product-by-product procedure now required.

Administration officials say this is mandatory if the U. S. is to survive in world markets, and they feel that such survival is necessary.

They cite the European Common Market arrangement as an indication of the growing trend to band together to reduce trade barriers between nations and stimulate a freer flow of goods.

As they see it, the U. S. needs

Says Steed: no law, no import controls

REP. Tom Steed (D.-Okla.) told the TIPRO import policy committee last week that "you must get something done in Congress this year (1962)" or be prepared to try to exist with no oil-import controls at all.

And if the latter happens, he said, the independent producer would never get another chance—he would be dead.

Steed charged that the future of the oil-import-control program is closely linked with administration plans to level barriers to free trade. The Reciprocal Trade Agreements Act, he pointed out, is up for extension next year. If it is not extended, he said, the present basis for limiting foreign oil is gone. And if it is extended without incorporating petroleum, the result would be the same.

Steed is chairman of subcommittee No. 4 of the House Small Business Committee. His subcommittee held hearings last month on the impact of oil imports on the domestic industry. He plans to resume these hearings in January. Steed told TIPRO committee that one of their biggest problems is to regain and expand their markets. "First there must be something to divide," he declared.

expanding markets abroad for products from its shops and factories, and it needs low-cost imports of goods and raw materials this nation does not have in sufficient quantities on an economic basis.

Meanwhile, the opposition is readying a campaign to tighten existing trade barriers.

The basic thesis of this group is that this nation's standard of living, its wage-hour laws and other "social" measures make it impossible for many industries to compete with cheap-labor products from abroad. Therefore, they reason, any general lowering of tariffs would be disastrous to U. S. industry and labor.

Obviously, these completely divergent views are going to clash when Congress resumes consideration of the Trade Agreements Act next year.

Not even the most optimistic of administration supporters expects the President to get his trade-liberalization program through Congress without making concessions to one group or another. This means that the industry that can swing the most votes, or that joins a coalition with other industries, will get the biggest concession.

Oil may be at a disadvantage in such a setting because it traditionally has tended to play a lone hand. Therefore, oil's fate may not be determined by what the industry itself needs or what it does but by what may become politically expedient when the showdown develops.

Furthermore, the industry itself is likely to be sharply divided over the best course for controls, particularly as they relate to residual-fuel oil.

Administration view. Currently, administration officials are playing down oil's involvement in the general trade battle.

They point out that because of its national security role, oil already has been placed in a special category and is likely to remain there.

Why, then, is the oil study being made at this particular time?

Administration spokesmen say there are several reasons. For one, the Kennedy administration has not made a top-level study of the oil-import program since it took office. Rather, it has been administering a program left over from the Eisenhower administration.

"If we were challenged on even such a basic point as the national security aspects of oil controls, all we could say at this time is that the past administration determined that security was threatened," one White House aide explained.

Also, he said, conditions may have changed since the control program was established.

"Anyway," he concluded, "we need to review the program from time to time to make basic decisions affecting it, such as what changes are needed, if any, to correct any inequities and to otherwise make the plan more effective."

These reassurances that the administration is "just taking a look" do not quite jibe with the evident skepticism over oil controls evident in some departments, at least at staff level. Whether this will be reflected by department heads remains to be seen because no oil issue has yet been determined at cabinet level during the current administration.

At any rate, producers clearly face an uphill fight in their efforts to get tighter controls. In fact, they face a period of uncertainty over just how much control, and in what form, they will be able to retain at all.

Some changes, at least in the mechanics of the program, can be anticipated. It is highly unlikely that after making a special, top-level study of the issue the current administration would adopt unchanged the program left to it by the Eisenhower administration.

Other aspects. It is altogether likely that the study group will search for factors outside of imports which may be depressiing the domestic industry unduly and thereby endangering national security.

That is, it may conclude that steps other than controls are needed to make the U. S. industry more able to compete in world oil markets.

Assistant Secretary of Interior John M. Kelly raised one such possibility recently when he spoke of "archaic" state conservation regulations (OGJ, Dec. 11, p. 54).

It is not likely that the study group will recommend any specific course of action to the states. But it could put the spotlight on such issues as a part of its determination of what steps are needed to strengthen the domestic industry.

Independents

INDEPENDENT oil producers throughout the country began girding last week for an all-out battle to write an effective import limiting program into law at the coming session of Congress.

The general feeling is that unless the President can be persuaded to reverse his field and tighten the current program, independent producers have no choice other than to go for legislation.

One reason is that independents were expecting beneficial changes in the program and a substantial reduction in imports next year. But they were chilled instead with no program change and a healthy boost in imports. This, they charge, is deepening an already critical wound.

But the fear goes much deeper. There is widespread foreboding now that domestic producers will be left at midyear with no import controls at all, if they sit by and do nothing.

Principal basis for this fear is a growing conviction that in the President's view oil-import controls are not compatible with his free-trade objectives.

Import committees of Independ-

New oil import

OIL-IMPORT allocations for the first half of 1962 were announced by Interior Department last week.

Basically, the program will be virtually the same as it is now. This is because the administration refused to approve revisions by Interior which would have cut more than 50,000 bbl. daily from the level of crude imports during the first half of 1961.

There are some adjustments, however, to meet slightly changed conditions in Districts 1-4 and in District 5.

The new program calls for licensed imports of crude and unfinished oils into the U. S. at a rate of 919,837 bbl. daily.

This includes 704,116 bbl. daily for Districts 1-4 and 215,721 bbl. daily for District 5.

The total for the U. S. is about 12,000 bbl. daily above the first 6

plan fight for import-control legislation

ent Petroleum Association of America and of the Texas Independent Producers and Royalty Owners Association met separately in emergency sessions in Dallas last week.

Both indicated strongly they will go to Congress to get an import program which would restore and maintain the health of the domestic oil-producing industry.

Observers from other producer associations in Texas and other states attended the meetings. Their representatives pledged early co-operative action.

Appeal to President. Following its meeting the IPAA committee immediately wired the President urging that he reconsider his December 2 decision to defer revision of the import program.

Besides the wire to the President, Dallas meeting empowered IPAA "immediately and vigorously" to:

Urge the President to "take immediate action to assure effective import limitations by revising the present program in accordance with the recommendations adopted by this association at its annual meeting on Oct. 31, 1961."

Advocate and support congressional action necessary to accomplish these objectives.

Invite and solicit the active cooperation of other trade associations, companies, groups, and individuals in a common effort to maintain U. S. energy supremacy as a deterrent to war and a foundation for economic growth.

Pledge continued cooperation with the Government in every program to restore a vigorous and expanding domestic petroleum industry capable of providing adequate and available supplies of oil and gas in the interest of national security.

Congressional action? Best odds were that the IPAA will do its best to persuade the President to reconsider and act now to revise the mandatory program.

If this fails, then it appears the association likely will go to Congress with a bill incorporating all or most of its views.

Mention in the resolution of the "recommendations adopted" by IPAA at its annual meeting referred to a list of 12 points which the association reaffirmed in a resolution.

These propose that, for example, imports be based generally on 10% of crude demand, rather than 9% of product demand; that there be no provision for imports of unfinished oils; that there be no exemption for asphaltic content of imported crude; that historic allocation be eliminated; and that overland imports be deducted from over-all permissible imports into Districts 1-4.

TIPRO moves. TIPRO, meeting a day later, pledged itself to begin work immediately to get restrictive oil-import legislation before, and through, the Congress.

It declared it is not wedded to any specific method or bill and would support any measure which can be developed to adequately restrict imports.

TIPRO clearly indicates that it thinks it absolutely vital now for oil producers to work with the coal industry and any other threatened by imports of oil or any other commodity.

Like IPAA, TIPRO immediately appealed to the President to come out now with an administration plan to cut imports.

quotas are 18,000 bbl. daily above current level

months of this year. Districts 1-4 gained about 14,000 bbl. daily while District 5 lost about 2,000 bbl. daily.

The increase for Districts 1-4 is even greater, however, when compared with the level of 670,933 bbl. daily permitted during the last half of this year.

The decrease for the West Coast is also greater when compared with the 230,298 bbl. daily currently being imported.

Thus on January 1, imports in Districts 1-4 will jump almost 34,000 bbl. daily while District 5 imports will drop almost 15,000 bbl. daily.

The gain in Districts 1-4 is due to a slightly higher demand forecast by the Bureau of Mines, while the drop in District 5 was caused by an increase in Canadian imports.

Other import levels established for the first half of 1962 are 76,434 bbl. daily for finished products imported into Districts 1-4 and 10,697 bbl. daily of products, including residual fuel, into District 5. These figures remain unchanged from period to period because they were fixed at the 1957 import levels at the beginning of the mandatory program.

For Districts 1-4, allocations for historic importers were made on the basis of 72.8% of their last allocation under the voluntary oil-import program. This is an increase of 0.8% over the figure applied during the first half of 1961 and is accounted for by the slightly higher total allocation for these districts.

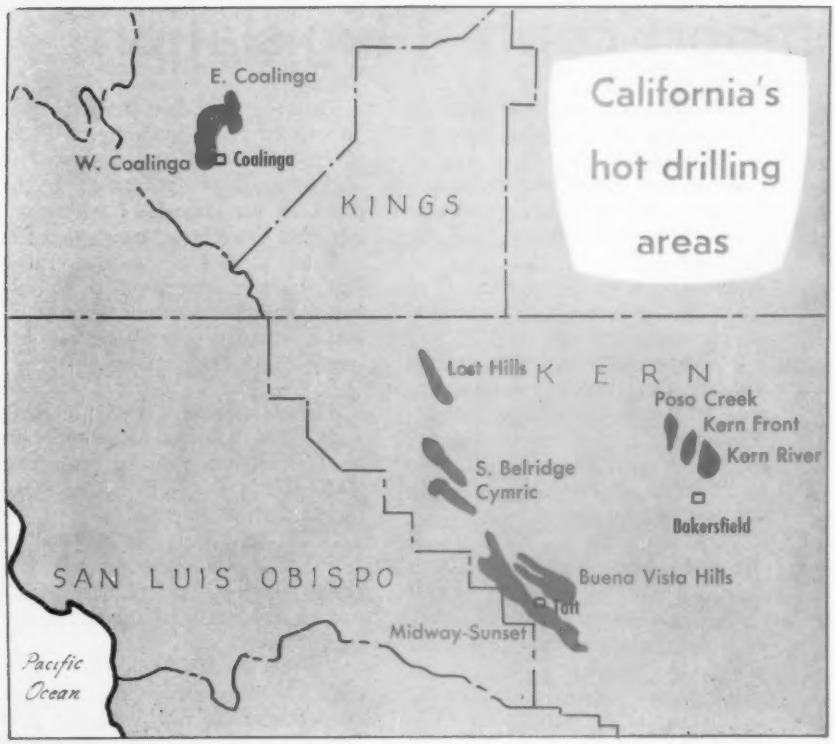
In District 5, historical importers will get 65.9% of their base-year allowable.

In Districts 1-4, for refiners whose allowables are based on refinery throughput, the following sliding scale has been applied:

Avg. B/D input	% input
0- 10,000	11.6
10,000- 20,000	10.7
20,000- 30,000	9.7
30,000- 60,000	8.7
60,000-100,000	7.7
100,000-150,000	6.7
150,000-200,000	5.7
200,000-300,000	4.7
300,000 plus	3.8

For District 5, the sliding scale is as follows:

Avg. B/D input	% input
0- 10,000	39.6
10,000- 20,000	30.8
20,000- 30,000	22.4
30,000- 60,000	13.2
60,000-100,000	10.7
100,000-150,000	9.7
150,000-200,000	8.7
200,000 plus	6.9



Oil fields with high activity
(Completions during Sept., Oct., Nov.)

West Coalinga	
Standard of Cal	48
East Coalinga	
Standard of Cal	4
Others	1
Cyrmic	
Standard of Cal	40
Others	5
Poso Creek	
Standard of Cal	14
Lost Hills	
Standard of Cal	35
Others	6
Buena Vista Hills	
Standard of Cal	3
Others	1
South Belridge	
Standard of Cal	10
Others	23
Kern River	
Standard of Cal	15
Others	19
Kern Front	
Standard of Cal	15
Others	6
Midway-Sunset	
Standard of Cal	28
Others	21
10-Field Summary	
Standard of Cal	212
Others	82
Total	294

Activity high in low-gravity fields

Standard of California has stepped up drilling in shallow San Joaquin Valley fields, completing 212 wells in the last 3 months. California's tight crude situation is making these old fields look better all the time.

Carl J. Lawrence
West Coast Editor

THE shallow, low-gravity fields in the San Joaquin valley are the current glamor girls of California's oil industry.

The crude in the fields is still heavy and on the low end of the gravity scale. But circumstances have changed and now the fields are among the best-looking development prospects in the state.

Drilling in 10 fields in the valley accounts for about 50% of the state's activity. And this has been the case for about 3 months. The fast pace—completions are running 3 a day—is expected to continue throughout December and may reach into the first quarter of 1962.

Standard Oil Co. of California is by far the dominant figure in this new drilling in the old fields, picking up the ball from Tidewater Oil Co., which led activity until September.

Of the 292 completions made in the 10 fields during September, October, and November, Standard of Cal has made 212 or roughly 75% (see table).

Last week Standard of Cal had 44 active locations in the 10 fields in Kern and Fresno counties. Just counting these wells, the company will have racked up a completion total of 252 since September 1.

Standard of Cal has about 20 rigs running in the fields. The company has drilled 359,518 ft. of hole in the 212 wells completed since September 1 for an average depth of 1,693 ft. per well.

The increased drilling in the San Joaquin valley has jumped California's active rig count from 78 on September 4 to 116 on December 11, an increase of 38 rigs.

The new drilling also is expected to kick up the state's completions sharply this year over last. So far this year, operators have filed notices to drill 2,154 wells, compared with 1,750 for the same 11 months of 1960. This is an increase of 404.

Why the interest? California's tight crude situation is causing this new interest in fields which as recently as 3½ years ago were all but being ignored as far as big drilling budgets is concerned.

The state's demand is continuing to increase at the rate of about 3 to 4% a year, but crude production has been dropping and discoveries have been falling off at an even more rapid rate. With a rising demand and a lack of new fields to work, operators are forced to turn to the old fields.

An indication of the change in attitude toward the fields is the state's shut-in production. In June

1958, shut-in production in California hit an all-time high of 56,913 bbl. daily. Much of this was in the valley. Today there is no shut-in production other than those wells which might damage reservoir conditions if produced.

The firm demand for residual fuel oil in District 5 is a prime reason Standard of Cal is moving into the low-gravity fields. The high resid cut from the heavy crude is needed by Standard to meet its big fuel oil demand.

Tidewater uses the crude differently. With a big coker at its Avon refinery, the company processes the crude for a higher gasoline yield.

Increased output. No figures have been released showing how much the stepped up drilling has increased Standard of Cal's production, but the new wells are expected to make a substantial increase for a few months.

Tidewater increased its production 5,147 bbl. daily by completing 261 wells in Kern River field from May of 1960 through last September. Kern River produces 13°-gravity crude, which is about par for many of the wells being drilled by Standard of Cal.

Tidewater's crash drilling program came in two spurts, but unlike Standard's, was limited to one field, Kern River.

During the first phase of Tidewater's program, the company completed 195 wells in Kern River between May 1, 1960, and January 1, 1961. The company moved back into the field with several rigs last summer, drilling another 51 wells. A few wells were completed in the intervening months, bringing the field's total in 16 months to 261.

Production during the 16 months increased from 9,118 bbl. daily to 14,265, an increase of 5,147 bbl. daily. This increase figures out to an average completion rate of 19.7 bbl. daily for 261 wells. The company completed 12 wells in Kern River in September, but dropped off to 3 in October and 1 in November.

While the San Joaquin valley completions are increasing the state's production, they also are pulling down the initial production rate of all wells completed in the state. Many are being completed pumping less than 20 bbl. daily.

During the first 10 months of the year, the initial production rate per well for the state's 1,120 completions was 65.9 bbl. daily. This is 24% below the initial production rate of 87 bbl. daily for the 917 wells completed during the same period last year.

The future. The drilling done by Standard of Cal and Tidewater is expected to set the stage for secondary recovery projects in some of the old fields.

Many of the wells are being drilled on 2½-acre spacing or closer. This close spacing is needed to drain the viscous crude from the thick sands, but such spacing also will be needed once the companies start secondary-recovery projects.

Neither company has announced any flooding plans for the fields, but all are candidates once production begins to decline in the areas now being drilled.

New Oklahoma-to-St.Louis gas pipeline near

Oklahoma Illinois Gas Pipeline is signing up St. Louis-area industrial customers and expects to seek FPC approval of project early next year.

BACKERS of a proposed new gas line from Northwest Oklahoma to St. Louis expect to announce within the next 2 weeks the signing of industrial customers who will take some 125 million cubic feet of gas daily.

A Fish Engineering Co. spokesman in Houston said that Oklahoma Illinois Gas Pipeline Co., organized to build the line, will file an application with the Federal Power Commission early in 1962.

Oklahoma Illinois is owned jointly by Fish, Pan American Petroleum Corp., and Shell Oil Co. Fish will design and build the 600-mile line, and Pan American and Shell will furnish all the gas reserves from Anadarko basin fields in western Oklahoma (OGJ, June 5, p. 45 and Oct. 23, p. 86).

The line will have a capacity of about 250 million cubic feet daily. Diameter of the line will be about 22 or 24 in.

The Fish spokesman said industrial customers are being signed in the St. Louis and East St. Louis area, and a sufficient number should be acquired in the next few days to guarantee construction of the line.

Supplier criticized. The project got indirect support recently from an FPC examiner who handed down a decision highly critical of Mississippi River Fuel Corp., now the sole natural-gas supplier in the St. Louis area.

Examiner Francis L. Hall asked criminal proceedings against Mississippi and its officers and directors for expanding their facilities without FPC approval. He also ordered the company to apply for authority to continue operating its facilities built without authorization.

Hall was ruling on a complaint by Laclede Gas Co. that Mississippi River Fuel has repeatedly refused its requests for additional gas. It also objected to a tariff provision which prevented Laclede from taking all the gas for which it had contracted.

In his findings Hall was highly critical of Mississippi's "purposeful avoidance of needed expansion." By not expanding, he said, but having a subsidiary build a line to provide additional gas, the company was able to "force customers to pay higher rates" than would have been possible had the company expanded its own system.

Hall also accused the company of withholding gas from its utility customers in order to sell it to industrial firms at a higher rate. It was in this area that his ruling was primarily effective. Hall directed that all of the gas now going to industrial customers, except a minor amount for pilot-light service, be allocated to the utility companies.

The decision is subject to review by the full commission.

Now everybody on the gulf wants West

For years sour-crude producers in West Texas had trouble finding markets. Now big buyers are taking all they can get because sour lays down at Gulf Coast refineries as much as 30 cents a barrel cheaper than East Texas sweet.

IF you've been thinking lately that there isn't much West Texas sour crude looking for market, you're exactly right.

In an abrupt reversal, West Texas sour has become much in demand by Gulf Coast refiners.

Need proof? There's quite a bit close at hand.

The scuffle in recent weeks between three crude - gathering companies to buy sour oil in the Sharon Ridge area of Scurry and Mitchell counties is one good pointer.

This is an area where the small independent producer has traditionally had fits trying to sell his oil—one of the chronically depressed oil-producing regions. Now three purchasers for several weeks have been fighting to buy it. As one Sharon Ridge operator told the Journal last week: "A couple of years ago we couldn't get rid of this crude. Now it seems as if everybody wants it. It's a welcome change."

Gulf Oil Corp.'s public announcement that it is selling 2,500,000 bbl. of crude in December is another good indicator. Gulf sold a like amount last month. It has surplus crude because a strike has cut deeply into the operating rate at its big Port Arthur refinery.

The fact that a company can sell this much oil without apparent trouble in an era of surplus is noteworthy in itself. Reliable reports are, however, that the bulk of this crude is West Texas sour. And such sales are even more remarkable when you consider that Gulf is posting prices for West Texas sour from 6 cents to more than 20 cents a barrel higher than most of the other major purchasers—and apparently getting these prices in its sales.

How come? The reason major purchasers are going after West Texas sour is a simple one . . . the price is right.

Right now, there are four different postings for this crude.

The highest is Gulf's $3.01 price for 40°-gravity, with a 2-cent differential downward for each degree drop in gravity.

Next is Indiana Oil Purchasing Co.'s $2.95 per barrel top with a 2-cent downward differential.

Atlantic posts $2.87 with a 2-cent downward differential.

All other major buyers, however, price 40°-gravity West Texas sour at $2.95 with a 3-cent drop for each degree drop in gravity. And most of the area oil goes at this price.

The average gravity for West Texas sour is said by most purchasers to be about 32°. The prevailing price for this gravity oil is $2.71. The scale paid by Atlantic and that posted by the majority group meet at that gravity level. And higher prices are paid only by Gulf and Standard Oil Co. (Ind.).

With a gathering charge of about 5 cents, a trunk-line charge of about 17 to 19 cents, and an evaporation charge of ½ to 1%, this oil lays down at a Gulf Coast refinery at about $2.95 a barrel.

East Texas field crude, at posted price of $3.10 a barrel, comes into the same refinery at about $3.26 a barrel. This includes a combined gathering and trunk-line charge of about 15 cents a barrel plus evaporation or "pipeline" charge.

There is a difference here between West Texas sour and the higher-gravity East Texas oil of roughly 30 cents a barrel at the refinery gate.

Oil gravity isn't as important a consideration as it used to be.

And the gravity differential be-

New crude-gathering company has

MESA Pipeline Co., a new crude-gathering and purchasing company headquartered at Midland, last week appeared to be winning a three-way contest to buy the bulk of sour oil produced in the Sharon Ridge area of West Texas.

At last reports, Mesa, headed by Murphy Baxter, Midland independent, had signed contracts with Sharon Ridge producers aggregating more than 3,200 bbl. of oil daily. And the Midland company claimed still more contracts were coming in.

This, it said, was enough to justify building its planned 60-mile 2-in. to 10-in. gathering system. The company had surveyors and right-of-way men in the field last week. Its system will deliver the crude to Texas Pipe Line Co. at that firm's China Grove terminal in southern Scurry County for delivery to Signal Oil & Gas Co. under a reported 10-year contract.

The project calls also for a 120,000-bbl. crude collection and discharge tank at China Grove.

Its oil-purchase contracts bind Mesa to pay the average of the posted prices of three major-company purchasers in the area, less gathering charges. Sharon Ridge oil generally ranges in gravity between 28° and 30°.

The gathering charge applied to these prices would vary with the total crude volume taken by the pipeline. It would be 10 cents a barrel if the volume were 5,000 bbl. daily or less, 9 cents if between 5,000 and 10,000 bbl., and 5 cents if in excess of 10,000 bbl.

Mesa also has pledged to build and finance salt-water disposal systems, either jointly or individually, for those Sharon Ridge area producers who desire the company's assistance. The disposal facilities, it says, will be owned by the participating producers after Mesa recovers its costs.

Permian drops out. Meanwhile, Permian Corp., one of the other two contenders, abandoned plans it announced late in November to build a line to serve the same area.

Texas sour

tween East Texas crude and West Texas sour isn't nearly enough to make up the price difference.

Coastal refiners now are well equipped to handle sour crude. As one buyer says: "You're talking about crude 30 cents a barrel cheaper at the refinery. And we can grind up West Texas sour as easy as East Texas sweet."

West Texas sour's cheap price, another buyer says, "has made it the most tightly held crude in the country."

A third asserts that Illinois basin crude "is the only other oil in the country that might be as popular."

"West Texas sour," he says, "is in very tight supply. And prospects are that it will continue that way for some time. Buying by major companies this month to meet their individual LIFO inventory problems may cloud the true picture some, but you can count on West Texas sour staying tight unless the price goes up."

A fourth veteran purchaser doubts there would be any trouble in selling all of the West Texas sour that would result from a "10 or 11-day producing schedule in Texas, though the market in other areas would be thrown out of balance."

Price increase coming? With two major buyers, Gulf and Indiana Standard, posting higher prices in response to West Texas sour's clear-cut price appeal, you might expect a general price increase for this crude.

With this kind of demand situation and with four separate postings, the odds in favor of a general upward move would have been overwhelming several years ago.

Now it's not so certain.

The consensus of a Journal sampling of crude-buyer opinions is that the prevailing price for West Texas sour is too low, with Gulf a little high, and Indiana about right.

But most buyers also appear to feel that the different postings are not going to merge into one going price anytime soon. Eventually maybe, but there won't be a rush.

The reasoning is about the same in each case. Oil companies are still running scared because of the Tulsa antitrust case. They are avoiding anything that could possibly smack of collusion.

No buyer switching. The pronounced range in prices paid for West Texas sour so far has caused little if any switching by producers from one buyer to another with a higher posted price.

Crude-oil representatives, furthermore, do not expect to see such switching on a large scale.

There are, they say, two reasons.

One is that sour-crude producers in West Texas have had lots of trouble getting firm markets in the past and they "won't be quick to desert any buyer who is now providing them one," one representative says.

The second, he adds, is that those majors posting higher prices will not likely accept oil from a producer they know wants to switch for the higher price. "The buyer losing the oil could treat you the same way in another area some time," he says.

edge in three-way battle to buy Sharon Ridge oil

West Texas sour postings

Gravity	Gulf	Indiana	Atlantic	Other majors
40-45°	$3.01	$2.95	$2.87	$2.95
39	2.99	2.93	2.85	2.92
38	2.97	2.91	2.83	2.89
37	2.95	2.89	2.81	2.86
36	2.93	2.87	2.79	2.83
35	2.91	2.85	2.77	2.80
34	2.89	2.83	2.75	2.77
33	2.87	2.81	2.73	2.74
*32	2.85	2.79	2.71	2.71
31	2.83	2.77	2.69	2.68
30	2.81	2.75	2.67	2.65
†29	2.79	2.73	2.65	2.62
28	2.77	2.71	2.63	2.59
27	2.75	2.69	2.61	2.56

*Average gravity of West Texas sour.
†Average gravity of Sharon Ridge area sour.

Bill Kleine, vice president, said last week that it now appears the venture could not be a profitable one in that the volume of Sharon Ridge oil now available "is not sufficient to support the project."

Permian will, he said, "continue to buy and truck roughly 1,000 bbl. that it is now gathering" for resale to Cities Service Co.

The company had planned a 50-mile system to carry both crude and salt water to China Grove where it now has a storage terminal. It would have built the system, plus oil and salt-water separation facilities, at China Grove and started operations by March 1.

Price boosted. The third company in the scrap for Sharon Ridge crude, and the only one with a pipeline already serving the field, is Southwestern Hydrocarbon Pipeline Co., Corsicana.

Southwestern, which has been buying about 4,700 bbl. daily of Sharon Ridge crude and reselling it to Cosden Petroleum Corp. and Col-Tex Refining Co., has moved to try to hold or improve its position.

The company announced that it had assigned its contracts with the two refining firms to another purchaser which it did not identify. The new arrangement, it said, would permit increasing payment to producers of 5 cents a barrel. Reports are that this would be accomplished by reducing the gathering charge to producers by 5 cents.

It appeared last week, however, that this move has had no effect on the Mesa project though it may have helped kill the proposed Permian line. Many Sharon Ridge independents have been irked in the past not only by the low prices paid for their oil but also by a requirement that they furnish pumps and lay delivery lines to get their oil to the only pipeline serving the field.

The 5-cent hike in posted price announced December 1 by Southwestern Hydrocarbon was the second increase announced by that firm in recent months. Prior to the first it was paying a flat $2.42 a barrel for Sharon Ridge oil, regardless of gravity. A few months ago it announced a 10-cent a barrel increase and began posting on a gravity scale. Some irate producers charged, however, that they were being paid less than before, with lower-gravity oil going for only $2.37 per barrel.

Markets calmer, but battle isn't over

Gulf slows down the spread of its economy regular because of supply problems. Company also doesn't want its promotions to compete with Santa Claus. Markets are now stabilizing after initial shock.

THE spread of Gulftane has slowed down in the East, picked up an avowed competitor in the Southwest and Southeast, and at least for the moment has lost some of its steam as a market disturber.

An uneasy calm, however, pervades all markets where Gulf Oil Co. has introduced its new economy regular; and the last chapter is far from being written on the marketing struggle.

The slowdown may be attributed largely to a tighter Gulf gasoline supply caused by a strike at the company's Port Arthur refinery and the week-long shutdown of a cat cracker at the Philadelphia plant.

It also appears that Gulf temporarily has put the brakes on its big promotional push that accompanies introduction of Gulftane for fear it will not be heard over the din of Christmas advertising.

In vital eastern and midwestern markets this is the picture:

Pennsylvania—Break in majors' prices came in 11-county Pittsburgh zone when Atlantic responded to Gulftane competition by dropping tankwagon price 0.8 cent and retail 1 cent to 26.9. Gulftane had come into Pittsburgh at range of 24.9 to 26.9. Esso recognized the change. Elsewhere in the state, Gulftane remained even with the private brands with majors generally 2 cents higher.

New Jersey—Both private brands and majors continued to hold the line in spite of competitive pressure from Gulftane. Reluctance to abandon fair trade and return to the "bloody Jersey" conditions of 5 years ago so far has prevented any marketer from recognizing the new pricing competition. Some majors reported they have not yet begun to lose volume to the lower priced Gulftane.

Indiana—The Indianapolis price war has entered a new phase. Only 2 weeks ago, most marketers were down to 22.9 cents retail for regular with others at 19.9 or 20.9, all meeting nearby Gulftane prices. Then Gulf moved Gulftane to 27.9. Other majors put their regular brand at 28.9, and the private brands generally settled at 27.9. This new price level has held for a week while private branders have cut station hours and personnel to ease their price squeeze.

In Columbus, Ind., Gulftane came in at 30.9—1 cent above private brands and 2 cents below majors. Majors dropped to the Gulftane price and private brands unaccountably rose 1 cent to the same level. In Fort Wayne and South Bend, Gulftane opened 2 cents under majors but did not put up the usual big curb price signs. As a result the competition didn't react. In Evansville, no one moved for several days, but the majors finally dropped to 1 cent above Gulftane at 24.9.

Other areas—Gulftane now has arrived in major marketing areas in Texas, Louisiana, Arkansas, Mississippi, Tennessee, North and South Carolina, Alabama, Georgia, Virginia, Maryland, Kentucky. The pattern still developing in the majority of these areas is for Gulftane to come in priced even with private brands and for other majors to drop within 1 cent of that level. In some cases private brands cut, and price wars start. Where private brands stay hitched, prices remain at their uneasy level.

The Tenneco plan. A major marketing newcomer, meanwhile, has revealed details of how it plans to meet Gulftane competition head on.

Tenneco Oil Co., an affiliate of Tennessee Gas Transmission Co., has installed a third grade in 50 Texas and Louisiana stations which compete with Gulftane and expects soon to have it in 200 more stations in the Southeast.

Tenneco has not yet named its three gasolines. Its new regular has the same octane rating as the old regular but fewer additives. The new middle regular has a higher octane rating, and the premium will meet needs of all cars using superpremiums.

Tenneco's policy is to match the Gulftane price with its lowest grade wherever Gulftane competes. The company will not necessarily be meeting independent brand prices.

Tenneco has about 380 stations in 26 states marketing under the Tenneco brand and 600 other stations using the Bay or private flags. The company said it had to make no physical modifications of its 50 stations where the special regular has been introduced. All had extra storage tanks and pumps installed when built.

A tub thumper. Marketing men are interested in one aspect of how Gulf introduces Gulftane to an area. That's the heavy fanfare of newspaper and television advertising.

Full-page newspaper advertisements proclaim the arrival of Gulftane as: "Gulf's new lower price quality gasoline made for the 50% of the nation's cars that don't need—in fact can't make use of—extra octanes."

These are followed by full-page ads promoting the upgraded new premium, No-Nox, as "the finest premium gasoline ever made" with a minimum 100-research-octane number and all the additives that were in Crest, the abandoned superpremium.

Next come spreads featuring both subregular and premium gasolines followed by a campaign promoting only the premium. After the initial advertising blast announcing Gulftane, the advertising emphasis shifts to the premium gasoline. Newspaper promotion is supplemented by television spot announcements during prime viewing hours.

In the New York area, the campaign features only the new premium gasoline which is arriving at Gulf pumps ahead of Gulftane because of supply problems. The up-

graded premium is being sold alongside the superpremium until Crest tanks are emptied.

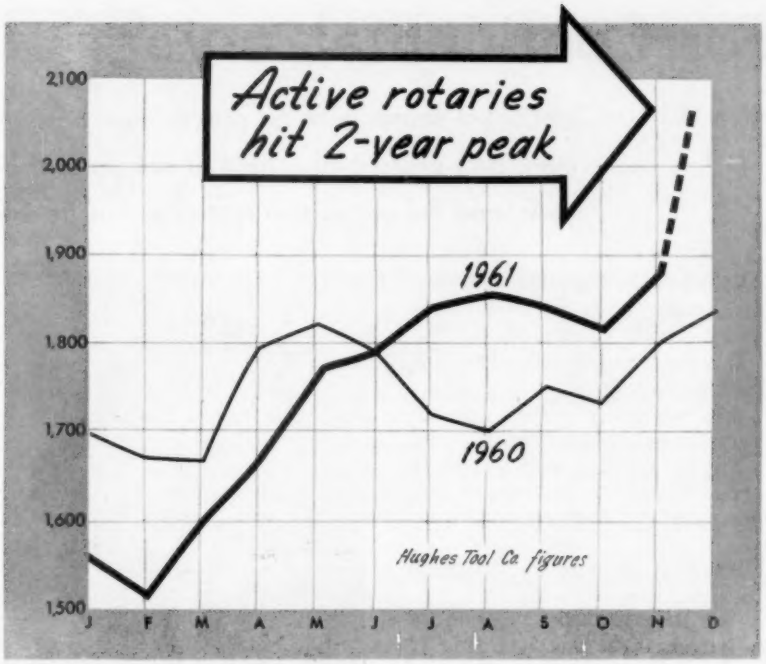
New York advertising sources say that newspapers will continue to carry the brunt of Gulftane promotion because of the regional nature of the campaigns. The ads appearing in 200 newspapers in 150 markets represent a departure for Gulf advertising. The company's print copy previously has been restricted to the Sunday supplements of newspapers and various magazines.

Kansas co-op acquires production in four states from Vickers

VICKERS Petroleum Co., Inc., of Wichita, Kans., has sold its working interests in oil producing properties to National Cooperative Refinery Association, McPherson, Kans.

The deal involves 101 leases with 265 producing wells and six secondary units with 607 producers located in Kansas, New Mexico, Oklahoma, and Texas. Purchase price was not announced.

Vickers retained its wildcat acreage, partnership working interests, over-riding royalties, producing royalties, and oil-payment properties.



Year-end rig activity soars

THE number of rotary rigs operating in the United States topped 2,000 during the week that ended December 11—a 2-year high.

Actual count was 2,036 rigs. This was an increase of 145 rigs over the previous 2 weeks, and the largest gain of the year.

A big portion of the 2-week surge can be credited to stepped-up activity in five areas. Kansas had an increase of 38 rigs, Oklahoma 36, South Texas-Gulf Coast 19, Texas Panhandle 18, and West Texas 29.

The higher tempo of recent rig activity will be reflected in well-completion gains during the early part of 1962.

Processing briefs

Contract for a 30-million-pound oxo-alcohols plant at Tidewater's Delaware refinery has been awarded to Badger Manufacturing. A joint venture of Tidewater and Air Products & Chemicals, the plant will make octyl, decyl, and tridecyl alcohols from a narrow-boiling-range cut of olefinic feed stocks. Completion date is mid-1962.

A gas-products plant will be built and operated by Cities Service Petroleum in Crockett County, Texas, about 20 miles southwest of Big Lake. The new plant will handle 15,000 M.c.f.d. of natural gas and will recover as separate products 50,000 gal. daily of propane, butane, and natural gasoline. Hudson Engineering expects to have the skid-mounted, low-temperature absorption plant ready for operation in May 1962. The plant will be jointly owned by several interests in the West World and Ranch Strewn pressure-maintenance units.

A fertilizer plant has gone on stream near Shell Oil's Wilmington-Dominguez refinery in Los Angeles. The 60,000-ton plant is owned by Shell Chemical, Stauffer Chemical, and W. L. Dixon Co. Dixon is operating the plant under the name of Dominquez Fertilizers. The plant's primary output will be ammonia and phosphate fertilizers.

A piperazine unit will be built by Jefferson Chemical at its Conroe, Tex., plant. Completion is expected during the second quarter of 1962. Jefferson presently produces piperazine in a semicommercial unit at the company's Austin, Tex., laboratories.

The second unit of Houston Chemical's complex at Beaumont, Tex., has been completed. The newest facility is an 80-million-pound-per-year ethylene oxide plant. Last September the first shipments of tetraethyl lead were made from a new antiknock additive plant.

Gas-processing facilities to handle 20,000 M.c.f.d. have been put on stream 10 miles west of Palacios, Tex. by Sunray Mid-Continent. The plant was designed and built by Weatherby Engineering, Houston, and will produce 18,000 gal. of products a day. The new unit is semiautomated and will be unattended 16 hours a day.

For Continental, a year of restraint

McCollum seems bent on practicing what he's been preaching as API chairman. He's prescribed a plan of restricted growth for his own company next year, and the suggestion is strong that he'd like to see others go along.

CONTINENTAL Oil Co. last week made news by announcing what it is NOT going to do in 1962.

It is not going to add a barrel of refining capacity.

It is not going to drill any unnecessary development wells.

It is not going to build a spate of service stations in the hope of capturing part of somebody else's market.

President Leonard F. McCollum explains it this way:

"We have adopted a program for the coming year that is geared to conditions as they exist and as we foresee them. We believe that this program will, in the long run, prove to be beneficial both to our company and to the industry."

It was the first "year-end" statement by a major-company executive, and this may have been deliberate.

It put Continental's plans on the record. And the plans obviously follow the suggestions made by McCollum to the entire industry when he was elected chairman of the American Petroleum Institute just a month ago.

McCollum said then that oil's economic problems could be wiped out if all companies made their 1962 plans on a realistic basis and didn't try to achieve a growth rate greater than is possible for the entire industry (OGJ, Nov. 20, p. 120).

Conoco's plans. McCollum said Continental will do more exploratory drilling next year, while holding development drilling to a minimum.

The company proposes to maintain, and if possible, increase, its reserves, he said.

In refining, Conoco will confine its spending to projects which will cut costs, improve product quality, or increase operating efficiency. It did not add a barrel of crude capacity this year and will not add any in '62.

In marketing, McCollum said Continental will build fewer stations next year, and those that are built will be in areas where population growth requires new facilities and where it's possible to make a profit.

Leonard F. McCollum
". . . facing up to reality."

At the same time, Continental will step up its abandonment of low-volume outlets.

Outside the United States, Continental plans "substantial" expenditures to develop reserves in Libya and to market production in areas of growing demand.

The problem. Today's circumstances require every oil-company management to "face up to reality and begin making more hard-headed decisions" regarding its day-to-day operations and future capital-investment policies, McCollum said. His reasons:

Demand this year rose only about 1%.

Supply exceeded this small growth in demand.

Inventories of crude and products, as a result, have risen to a record level and are roughly 10% more than is needed to meet "any unforeseen contingencies."

Prices reacted by dropping sharply, and oil-company earnings followed suit.

The excess stocks, McCollum said, helped make marketing unprofitable in many areas. The average level of nationwide wholesale prices has dropped 5.4% below last February and is now 3.2% under a year ago.

As an effective approach to the problem, McCollum suggested holding refinery runs to 1961 levels and meeting next year's expected 2.5 to 3% increase in demand by drawing down inventories.

Even this wouldn't be enough, he added, because the basic trouble of the industry has been the slowed rate of growth in demand, combined with overcapacity in nearly every phase of oil operations.

Whatever cuts down that overcapacity, he indicated, will help improve oil's outlook.

Start made on new East Texas gas line

BI-STONE FUEL CO., Corsicana, Tex., has started construction of its East Texas intrastate gas line.

The new line will move gas for Texas Power & Light Co., Dallas, from the Bethel producing area in Anderson County, East Texas, to that company's power-generating plants in the Sherman-McKinney area of North Texas (OGJ, Sept. 4, p. 99).

Contracts let so far cover only the southern half of the project. They went to Thomas Contracting Co., Houston. The contractor has set up project headquarters at Athens in Henderson County.

H. T. van Valkenburgh, Texas Power & Light official in Dallas, says completion of the southern segment is expected in mid-February. Completion date for the remainder is not yet certain.

The project includes roughly 100

miles of 16-in. main line from the Bethel area to Merit in Hunt County plus 75 miles of 10, 8, and 6-in. laterals. From Merit, the system will branch to the north and west. One 30-mile 10-in. lateral will extend straight north to serve a new TP&L generating plant now under construction at Savoy, in Fannin County, a few miles west of Bonham.

A second 30-mile 10-in. lateral will run due west from Merit to serve TP&L generating facilities in the McKinney-Denton area north of Dallas.

Van Valkenburgh confirmed that a portion of the gas supply for the line will come from Bethel Dome field in Anderson County and Tri-Cities field in Henderson County.

Available reserves in these fields, however, are not sufficient to supply a line of this size. And officials of both Bi-Stone Fuel and TP&L decline comment on other supply sources. It is reported likely that TP&L has its eye on new sour gas fields currently under development in the Smackover in the general vicinity.

Westcoast allowed to tap gas reserves in Boundary Lake South

FEDERAL approval to connect the gas reserves of Alberta's Boundary Lake South field has been granted to Westcoast Transmission Co., Ltd.

Westcoast received permission from the National Energy Board to take the gas, starting this winter, which has been purchased from Pan American Petroleum Corp. and Imperial Oil, Ltd. Westcoast estimates field reserves at 22.91 billion cubic feet while the NEB estimate is only 14 billion cubic feet. Westcoast forecasts depletion of the field in 7 years compared with an estimate of only 3 or 4 years by the board.

The gas will be delivered to the Westcoast system serving British Columbia and the U. S. Pacific Northwest through a 2.2-mile 16-in. line to be built by Alberta Gas Trunk Line Co., Ltd., a 1-mile 16-in. line to be built by Westcoast, and a 4.7-mile 16-in. line to be built by Gas Trunk Line of British Columbia, Ltd.

WATCHING WASHINGTON

with Clyde La Motte

OEP gets ready to go to work on new imports study

PLANS and procedures for the new oil-import study are still being shaped up.

The Office of Emergency Planning, which will have primary responsibility, is creating an interdepartmental committee. The first meeting is to be held this week.

One of the questions to be answered during the early stages is what method will be used to permit oil-industry segments and others to supply data and to voice their views.

Another question concerns whether residual-fuel control will be involved. Chances are that it will not, since OEP has already made a study of that. However, other departments may insist on including it in an over-all look at how oil imports fit into the nation's security and economic picture.

There is no chance that the study will be a "quickie." The President specified that the study be completed by mid-1962, and you may be sure it will not be done earlier.

Mid-March date likely for Louisiana offshore sale

DATE for a federal sale of offshore Louisiana leases has been tentatively set for March 16. The Bureau of Land Management last week was preparing detailed information, including tracts to be offered, for publication in the Federal Register. The notice will probably appear in the Register before the end of this month.

Meanwhile, an Interior intradepartmental committee, working with California state officials, will report by mid-March on progress of efforts to devise a plan for the start of federal offshore leasing there. At this stage, prospects for an agreement appear favorable.

Soviet oil creates problem in military purchasing

AN UPROAR may develop over the military's use of jet fuel made by a Japanese refinery which runs some soviet-controlled crude.

Officials of the company say the soviet crude is segregated and is not used in making the fuel sold to the U. S. military. But American-affiliated companies operating in Japan say that even if this is so, the refinery's use of cheap soviet crude enables it to underbid everyone else for the military set-aside for Japanese refineries.

FPC sets up new system for spotting work delays

IN AN EFFORT to spot bottlenecks more quickly and thereby be able to do something about them promptly, the Federal Power Commission has established a system of charting the flow of work through the agency.

In addition to a series of general charts, which include industry trends, there is a special board that shows the status of each major case and how long it has been in moving through each step.

The charts and the board will be updated at specified intervals to keep them current.

The material has already been used to support the agency's budget request for more hearing examiners and other staff personnel. The results will not be known, however, until the President sends his budget proposals to Congress next month.

Buried concrete tanks:

New LNG storage plan may cut costs

WORLD - WIDE interest is focused on an internationally sponsored test of storing liquefied natural gas in a buried concrete tank in Chicago.

The excitement surrounding the experiment stems from the likelihood of significant improvements in LNG economics. They would be achieved by cutting storage costs in half.

In an LNG project for peak shaving, gas would be liquefied and stored near markets during slack-demand periods for use on coldest winter days. Based on estimates using conventional aboveground double-shell metal tanks, storage would account for 50% to 60% of total investment.

Since liquefaction and regasification processes are well established, the only major opportunity for cutting is in storage. If predictions for halving storage costs are borne out, over-all investment would be reduced by 25%.

What is learned in the Chicago test—sponsored by the American Gas Association, U. S. private interests, and French Government interests—will affect projects under consideration around the world. If pre-test estimates are realized, underground concrete storage may be incorporated into the design of large LNG installations proposed in the U. S., Europe, and Japan.

1. AGA experiment

The Chicago experiment is the culmination of research sponsored by the American Gas Association (OGJ, Jan. 30, p. 90).

A 1,000-bbl. concrete demonstration tank, designed by Preload Corp., is being built of prestressed concrete. The structure, 8 ft. high and 30 ft. in diameter, will have a thin stainless - steel liner as a methane barrier on all surfaces of the tank.

The tank is about one-third complete. It should be ready for testing in February with liquid nitrogen at −320° F. Because of its availability, nitrogen will be used instead of natural gas, which is liquid at −258° F.

Prestressed concrete has proved to be a satisfactory structural material for low-temperature storage. A 16,000 - bbl. aboveground tank built by Preload for Linde Co., division of Union Carbide Corp., at its East Chicago, Ill., plant, was operated for 10 years storing liquid oxygen at −297° F. But no experience was available on belowground concrete tanks.

During the past 2 years, experimental work at the Institute of Gas Technology in Chicago, sponsored by AGA, provided new data on insulation requirements and soil behavior at low temperatures. IGT developed pressure-test procedures to predict pressures exerted on the tank by frozen soil.

The 1,000-bbl. tank now under construction is expected to demonstrate the soundness of the materials and design of an underground prestressed concrete tank for LNG.

Commercial-size unit. In addition, Preload has designed a commercial-size unit of 285,000-bbl. capacity—the liquid equivalent of one billion cubic feet of natural gas.

This capacity would be suitable for storage at the market end of a cross-country pipeline, such as the New York metropolitan area. Gas could be liquefied and stored at the rate of five million cubic feet daily for 200 days. Regasification facilities would be designed to empty storage during 5 to 10 days of peak demand in the winter.

Cost estimates indicate that an underground concrete tank of this size could be built for $3.50 per barrel, exclusive of land. This compares with about $8 per barrel for an aboveground double-wall metal tank. Studies show that when tank size reaches 75,000 bbl., underground concrete construction becomes cheaper than aboveground steel.

A facility incorporating underground storage of this type could provide peak-shaving gas at prices below any other method except underground storage in depleted fields.

Test - tank backers. The storage test is being sponsored by the gas industry through AGA, which is providing slightly more than half of the $150,000 cost, and by others with a stake in LNG.

Other participants are Gaz de France, Air Products & Chemicals Co., Linde Co., U. S. Steel Corp., and Bechtel Corp.

Gaz de France, a gas company controlled by the French Government, plans to import liquefied methane from Algeria. Linde is supplying the liquid nitrogen for testing and U. S. steel is supplying the metal liner.

Bechtel is interested in developing, designing, and building LNG facilities, and has been retained by Ohio Oil Co. and Union Oil Co. of California for this purpose.

2. LNG project prospects

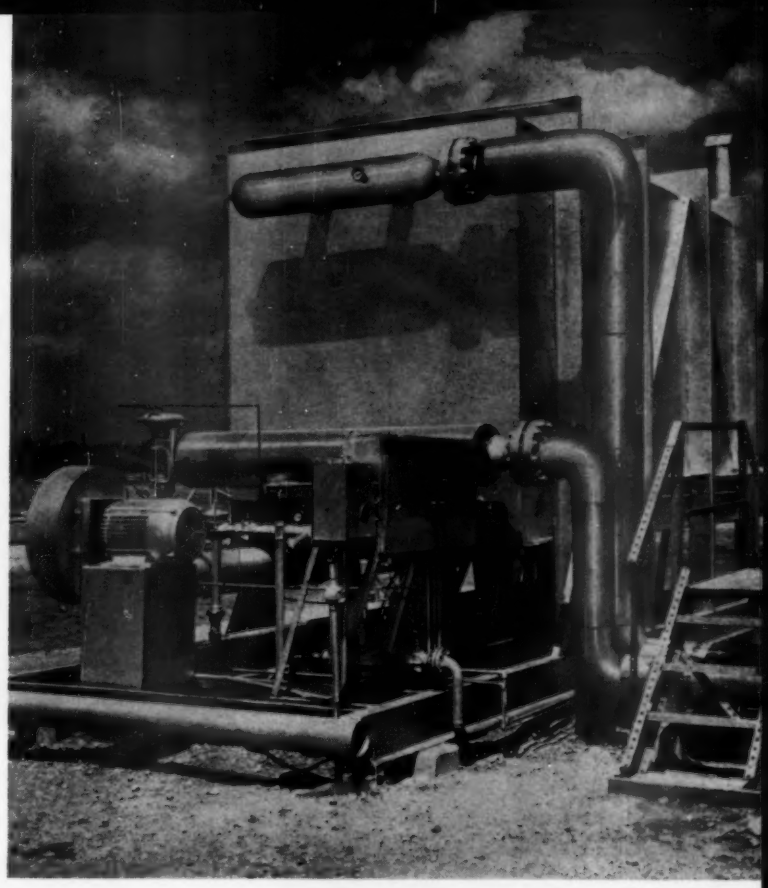
In the first definite commercial project to be announced. the LNG equivalent of 100,000,000 cu. ft. daily of natural gas will be transported from Algeria to London (OGJ, Nov. 13, p. 132).

This project is the outgrowth of shipments from Louisiana to London in the LNG tanker Methane Pioneer. It will be undertaken by the British Gas Council, British private interests, Conch International Methane, Ltd., and French interests.

Gaz de France, which is weighing both LNG and pipeline shipment of Algerian gas to France, is reported committed to an LNG project in 1963-64.

Ohio and Union have retained Bechtel to study three potential markets in California, Australia, and Japan, for three to five trillion cubic feet of Alaskan gas (OGJ, Sept. 18, p. 61). Japan is considered the best near-term market for Alaskan gas. California is out of reach economically for firm-load gas from LNG.

LNG is conceived as a base-load supply of fuel in high energy-cost areas outside the United States. Ap-



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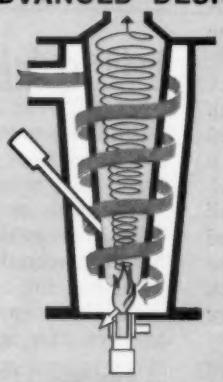
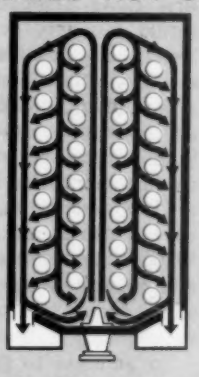


FUEL REACTOR . . . Rotational flow of entering air creates rapid fuel-air mixture. All combustion takes place within the Reactor. Hot, inert gases discharged into the cabinet at jet speed.



HEAT EXCHANGER . . . Hot, inert gases travel at high speed past muffle, turn, and flow down the back side. Heat flux is uniform because there is complete circulation, which gives same bulk temperature at front and rear of tubes.

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plication in the U. S. in the foreseeable future seems confined to peak-shaving using pipeline gas. At present field prices in the Southwest, U. S. gas piped to markets is several cents cheaper than LNG tankered from Venezuela or other sources.

A year ago a combine of 40 New England gas utilities, organized in the New England Gas Pooling Group, was the No. 1 candidate to build the first U. S. installation. A study made for the group by Stone & Webster Service Corp. indicated that a central LNG plant of three billion cubic feet capacity was the best solution to the peak-shaving problem.

Since then, member companies report improved prospects for winter service from their suppliers, Tennessee Gas Transmission Co. and Texas Eastern Transmission Corp., the latter through Algonquin Gas Transmission Co. Their interest in LNG has waned accordingly.

However, a few of the members, impatient with the pace of a large group and its inherent red tape, are investigating individual plants or plants serving two or three utilities. They have obtained engineering estimates on LNG costs which are more attractive than other peak-shaving sources.

Transcon to be first? Transcontinental Gas Pipe Line Corp. is now considered most likely to build the first LNG plant in the U. S. It would probably be located in the New Jersey meadows to serve utilities in the New York area. Transco, now studying the feasibility of such an installation, says it is interested in providing this storage service if its customers want it.

Utility interest in LNG is centered in the Northeast, Southeast, and West Coast where there are no conveniently located depleted gas fields for cheap storage, or where the capacity is inadequate.

In addition to the AGA storage test, other forms of storage are under development. Conch International and Constock Prichard Corp. have demonstrated the feasibility of using frozen earth as a storage tank (OGJ, Oct. 16, p. 60).

Fenix & Scisson, specialists in excavating caverns in impervious rock for storing LPG, are advocating the same type of storage for liquefied methane.

QUADRUPLE DRILL prepares shot holes for blasting trench in California lava beds for Alberta-to-San Francisco gas line.

Alberta gas will start long trip to

A NEW GAS transmission system, a 1,404-mile line made up primarily of 36-in. pipe, is about ready to go on stream.

The new system runs from the prolific gas area along the Foothills Belt in Alberta to the San Francisco area. All pipe is in the ground and the first gas is scheduled to be delivered before the end of December. Pacific Gas & Electric Co., the big San Francisco utility, is principal sponsor of the line and will receive the bulk of the deliveries. PG&E is slated to take 415 million cubic feet of gas daily once the line gets

Industry briefs

Fire losses in the petroleum industry last year were at an all-time low, API reports. Fire-loss ratio was 3 cents per $100 of insurable value. This is 39% below 1959 and the best record since API started compiling fire-loss figures 31 years ago. There were 15% fewer fires in 1960 than in the previous year.

Purchase of the S. D. Johnson interest in nine wells in Nebraska has been completed by Sage Oil Co. The wells are in Kimball, Banner, and Cheyenne counties.

Via an exchange of stock, Santiago Oil & Gas, Midland, Tex., is absorbing Tiger Minerals, Inc., Dallas. Tiger Minerals properties include 1,100 acres of partially developed oil-and-gas-producing leases in Duval County, South Texas. No estimate of value was given. Santiago has oil-and-gas production in Texas, New Mexico, Kansas, and Louisiana.

Mobil Oil is moving its California exploration offices from Bakersfield to Los Angeles. H. D. Hobson, division exploration manager, said the move was made because the company's search for new oil "is shifting to other areas" in the state.

Acquisition of Signet Oil & Gas Co., Denver, has been completed by Occidental Petroleum Corp. Occidental acquired various portions of the working interest in 12 producing gas wells on the McMullin

SNOW covered much of the Canadian Rockies late in the construction program.

STEEP mountains in British Columbia posed pipe-laying problems.

San Francisco by first of the year

into full service. Pacific Northwest Pipeline Corp. will take 151.7 million cubic feet at Spokane and Montana Power Co. will take 30 million in northern Montana (OGJ, Aug. 29, 1960, p. 47).

The line runs through land ranging from desert areas with an elevation of sea level to rugged Canadian Rockies and Cascade Mountain areas where the elevation hits 6,000 ft. There also are 14 major river crossings along the route.

The PG&E project will introduce Canadian gas to California, a deficit gas-producing state.

Ranch field in San Joaquin County, California, and in 21 wells located in Kimball, Banner, and Cheyenne counties, Nebraska, and Logan County, Colorado. The sale involved the issuance to Signet shareholders and certain of its participants of 213,302 shares of Occidental common stock plus about $1,000,000 in cash. Signet will be operated as a wholly owned subsidiary of Occidental.

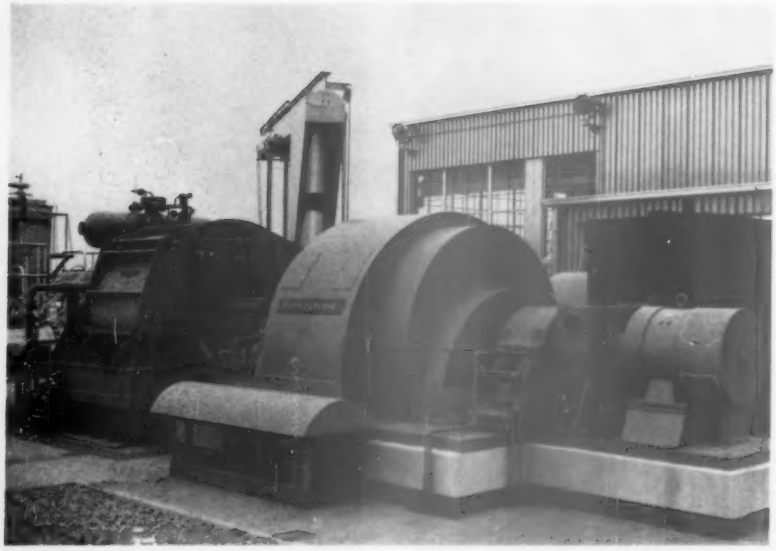
Secondary-recovery methods accounted for 19.3 million barrels or 17% of the oil produced in Kansas during 1960, the Kansas State Geological Survey estimates. Active secondary-recovery projects were reported in 51 counties.

Third-quarter earnings of 40 oil companies declined 2.9% from the period a year ago, but increases of 13.5 and 8.7% in the first and second quarters boosted profits for the first 9 months by 6.1%. According to a compilation by Carl H. Pforzheimer & Co., 28 companies recorded declines in the third quarter while 13 of the 40 were off for the first 9 months, compared to the same period last year.

A 3% increase over the past year in prices paid for natural gas in the Texas Panhandle has been reported by the Texas Railroad Commission. Hearing held by commission staff in Amarillo turned up information that the average price paid for gas sold on a 14.65-psi. pressure base is 11.7168 cents per M.c.f. This compares with an average price of 11.3057 cents a year ago.

New target depth of 14,000 ft. is being considered by companies participating in Dome Petroleum et al. 1 Winter Harbour on Melville Island in the Canadian Arctic (OGJ, Dec. 4 p. 101). Decision to deepen beyond original objective of 10,000 ft. was made because the Devonian section encountered was thicker than had been expected. At last report the well was below 9,600 ft. Two of the original participants—Bankeno Mines, Ltd., and Union Oil of Canada—will not participate in the deepening.

Proposed merger of Georesearch, Inc., Dallas, into Dorchester Corp., Amarillo, Tex., will be submitted to stockholders of both firms December 28. If approved, Georesearch stockholders will receive one share of Dorchester stock for each Georesearch share. Surviving company will be Dorchester Gas Producing Co.



Outside compressor cuts cost

IN PIONEERING outdoor installation of a large compressor unit, Texas Eastern Transmission Corp. has eliminated substantial building costs.

This unit—the first large outdoor compressor unit on a major gas transmission line—is the second of two units at the Tompkinsville, Ky., station. Each consists of a 15,000-hp. Westinghouse synchronous motor driving a De Laval single-stage centrifugal compressor.

The first unit, installed in 1956, is housed in a stainless steel building. The second, installed 4 years later, is an outdoor unit with its controls housed in the existing building (shown in photo).

Cost of the original station was $1,861,000, including approximately $126,000 for cottages, sewage system, water, gas, and landscaping. Thus the operating facilities cost $1,735,000 for the first unit. Operating facilities for the second unit cost $1,633,000. Net saving from the elimination of a building for the second unit was $60,000 to $70,000.

The small station crew of 7 men has not been increased.

Total cost of the Tompkinsville station, $3,494,000 or $116.47 per installed horsepower (based on 30,000 hp.), is exceptionally low. It is the result of concentrating electric horsepower in large units.

IRS clears sale of Republic Natural

TAX clearances have removed the final obstacle to the $148,500,000 sale of Republic Natural Gas Co. assets to Socony Mobil Oil Co., Inc., pending a vote by Republic stockholders December 28.

The Internal Revenue Service has issued favorable tax rulings to Republic, Socony, and others in the "ABC" transaction to be financed mainly through payments from future production. The other firms are Albantu Oil & Gas Corp., East Wall Street Corp., Long Point Corp., and Mon-Dak Oil Corp., which have purchased production payments.

Republic will realize $148,500,000 from the sale—$110,000,000 from the group buying the production payments and $38,500,000 in cash from Socony Mobil.

Albantu, East Wall, Long Point, and Mon-Dak will own 90% of the hydrocarbons produced from certain Republic properties until they have received $110,000,000 free and clear of operating and other expenses, plus 5½% interest. Socony will acquire other Republic assets and assume most of its liabilities.

Republic Natural, headquartered in Dallas, will be dissolved. It will distribute to stockholders its remaining assets, which are estimated to exceed $48 per share.

Republic output, reserves. Republic's reserves have been estimated at 2½ trillion cubic feet of natural gas and more than 30,000,000 bbl. of oil (OGJ, July 24, p. 39).

Producing properties are concentrated in the Hugoton area of Kansas and Oklahoma. Production also is located in Texas, Louisiana, and the Rocky Mountains.

During fiscal 1960-61, Republic gas sales averaged more than 187 million cubic feet daily from 500 gas wells. Oil sales in the same period averaged 8,900 bbl. daily from more than 600 oil wells. Of the company's 1,200,000 acres of proved or prospective holdings, 285,000 acres are under production.

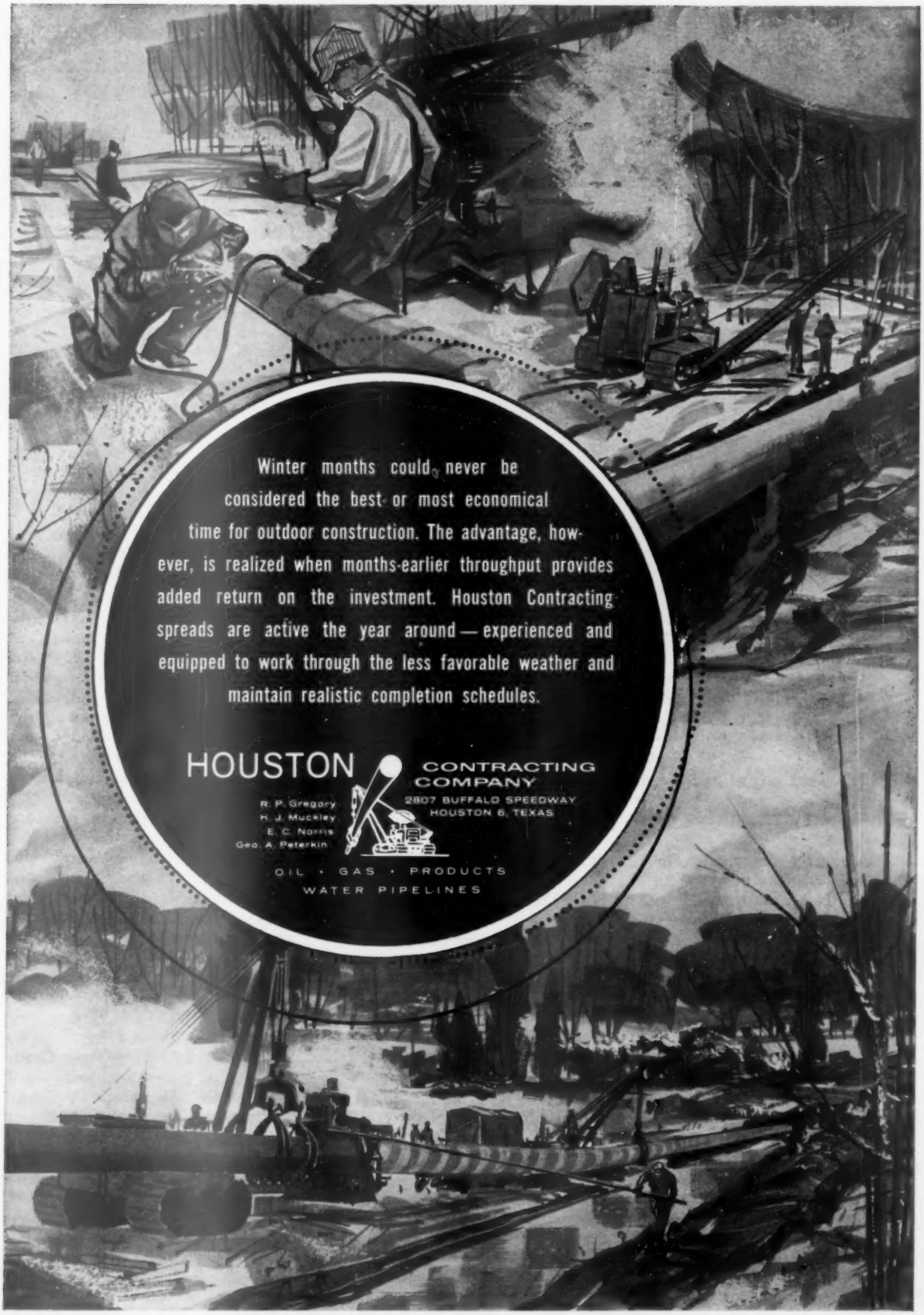
Hess oil properties valued at $108 million in Cletrac merger plan

THE Leon Hess oil interests have signed a merger agreement with Cletrac Corp., New York, crawler-tractor and road-building-equipment manufacturer, indicating a stock value of $108 million for the oil properties.

The owners of Hess, Inc., which operates an integrated oil business, will receive 6,354,291 new shares issued by Cletrac, formerly Oliver Corp., which has only 2,615,059 shares outstanding. Cletrac has been traded at between $17 and $18 a share on the American Stock Exchange for several weeks.

The merger is subject to a vote of Cletrac shareholders at a meeting scheduled January 10, 1962.

The effect of the merger will be to make the Hess family-owned business a publicly owned corporation. Hess will control Cletrac, which has been steadily getting out of the equipment business. The company will be essentially an oil operation, with a 75,000-bbl. daily refinery at Perth Amboy, N. J., producing properties, a fleet of tankers, and a terminaling-brokerage business in crude and products.


Winter months could never be considered the best or most economical time for outdoor construction. The advantage, however, is realized when months-earlier throughput provides added return on the investment. Houston Contracting spreads are active the year around — experienced and equipped to work through the less favorable weather and maintain realistic completion schedules.
HOUSTON
CONTRACTING COMPANY
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HOUSTON 6, TEXAS
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H. J. Muckley
E. C. Norris
Geo. A. Peterkin
OIL • GAS • PRODUCTS
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118

WINCH pulls 16-in. line across Delaware River to SunOlin chemical plant site in Delaware. Crane supports pulling head and float until they are in water.

Delaware River lines in place

Eight new pipelines, including world's longest nitrogen line, carry chemicals across river to New Jersey plants.

THE rapidly developing Delaware Valley chemical complex made another advance last week with completion of eight pipelines linking plants on both sides of the Delaware River.

The $4½-million project includes 94 miles of pipe from 4-in. to 16-in. diameter laid by SunOlin Chemical Co. from Claymont, Del., plants into New Jersey. SunOlin is an affiliate of Sun Oil Co. and Olin Mathieson Chemical Corp. The welded lines were winched across the river and buried in a trench 25 ft. deep and 6,000 ft. long.

The pipelines. Here is a list of the individual lines and the products they will carry:

A 22½-mile nitrogen line—the world's longest — which is 8-in. across the river, and has 6-in. branches to the Du Pont Chambers Works at Deepwater, N. J., and Shell Chemical Co. plant at Woodbury, N. J.

A 4-in. hydrogen line to Du Pont.

A 4-in. carbon monoxide line to Du Pont.

A 6-in. ethylene line to Du Pont and Shell.

A 4-in. propylene line to Shell at Woodbury.

A 6-in. products line to Sun Oil's Paulsboro, N. J., bulk terminal.

A 6-in. stainless-steel oxygen line which crosses the river but is not yet connected to any plant.

A 16-in. spare line across the river for an unspecified future use as a chemical carrier or as a casing for additional lines across the river.

Supplying plants. Chemicals piped to customer companies in New Jersey will be produced in plants being built by SunOlin and Air Reduction Co.

SunOlin will complete ethylene and ethylene oxide plants at Claymont later this year. In addition, hydrogen purification and carbon monoxide facilities are being completed.

Airco is building an air separation plant at Claymont—scheduled for completion in the second quarter of 1962—which will supply nitrogen and oxygen to New Jersey customers and adjacent SunOlin plants.

SunOlin hydrogen will be shipped to Airco's hydrogen liquefaction plant to be completed in Pedricktown, N. J., by early 1963.

Sun Oil will lease two lines for propylene shipments to Shell and for shipment of products from Sun's nearby Marcus Hook, Pa., refinery, to the New Jersey bulk terminal.

Pennsylvania Grade crude prices cut 17 cents by major buyer

PRICE of Pennsylvania Grade crude, long a preferred stock for lube oils, has been cut 17 cents a barrel.

The Joseph Seep Purchasing Agency of South Penn Oil Co., a major buyer of Penn Grade crudes, posted the cuts. Other buyers were expected to follow.

The new postings put Bradford district oil in Bradford Transit Co. at $4.63 per barrel; middle district grade oil in National Transit Co. $4.35; Pennsylvania Grade oil in National Transit Co. southwest division $4.08; Pennsylvania Grade oil in the Eureka Pipe Line Co. $4.00; Buckeye Pennsylvania Grade oil in the Buckeye Pipe Line Co. $3.91.

The 17-cent cut from a $4.80 high will price Pennsylvania Grade crude at its lowest level since April 1960, when a $4.70 top was posted. A 10-cent increase to $4.80 was made last May. Production of Pennsylvania Grade crude totals about 33,500 bbl. daily.

South Penn Oil Co. said two factors justified the decrease: crude-oil production greater than refinery demand and a serious drop in refinery realizations due to chaotic gasoline markets.

Mobil sets record casing string

THE WORLD'S longest string of 10¾-in. casing has been run by Mobil Oil Co. in a deep West Texas wildcat.

Mobil set 13,200 ft. of P-110 grade 10¾-in. casing weighing 65.7 lb. per foot. With a total weight of 867,000 lb., it also may be the heaviest string of pipe ever handled.

The string was run in the 1 State-McIntyre, being drilled in partnership with Sinclair Oil & Gas Co. in Pecos County's Rojo Caballos field. Parker Drilling Co. is the contractor.

The Mobil string was 177 ft. longer than the previous record-holder for 10¾-in. casing. That was a 13,023-ft. string run in U. S. Oil of Louisiana's No. 97 E. Cockrell, Jr., in South Louisiana early this year (OGJ, Feb. 20, p. 96).

The upper 6,000 ft. of Mobil's record string was run inside 13⅜-in. casing. The bottom 7,200 ft. of flush-joint pipe was run in a 12¼-in. hole. Special-clearance, buttress V-150 collars were used on the upper 6,000-ft. section.

Time required on the entire operation was 26 hours. The job involved 330 joints of pipe and 5,800 sacks of cement.

Mobil said no trouble was encountered, although much care was required because of the small clearance between casing and hole. Use of 10¾-in. casing will permit larger hole sizes and greater clearances for strings to follow.

This will make for faster drilling time.

The well is projected to 19,000 ft.

Louisiana ups allowable for 2 months

THE State of Louisiana has increased its production allowable for January and February by approximately 80,000 bbl. daily.

The depth bracket allowable was restored to 33% of the base March 1953 production. It had been 30% the last 6 months and 33% prior to that.

The 80,000-bbl. increase includes some 15,000 bbl. from expected new completions. The remainder will come from the higher per well allowable.

Total production for the first 2 months of 1962 will run to about 1,080,000 bbl. daily. Although nominations were not this great, Conservation Commissioner James H. Gill said that "general conditions" in the industry justified the increase.

In another development, the New Mexico Oil Conservation Commission last week set a January basic unit allowable of 36 bbl. daily, 2 bbl. above December.

New firm buys Onyx crude-oil gathering system in West Texas

ONYX Refining Co., Abilene, Tex., has sold its 350-mile crude-oil gathering system in West Central Texas to a new company, Resources Corp., for an undisclosed price.

Resources Corp. will lease the system to a third party, McWood Corp., another Abilene crude-gathering company.

The Onyx network has been gathering about 20,000 bbl. of West Central Texas crude daily. Roughly two-thirds of the total has been purchased by Mobil Oil Co., the remainder by Humble Oil & Refining Co.

McWood, new system operator, currently operates about 250 miles of gathering lines in Texas, Louisiana, and New Mexico.

Effective date of the transaction was December 1.

Pipeline briefs

More industrial gas is being delivered by pipeline. During 1960, according to the U. S. Department of Commerce, pipelines made these deliveries: 7,161,000 M.c.f. of hydrogen; 8,325,000 M.c.f. of nitrogen; and 22,242,000 M.c.f. of oxygen. The gases had a gross product value of $26,246,000.

A remote control and telemetering system will be installed on part of the Humble Pipe Line system by Motorola, Inc. Four remote stations, up to 200 miles apart, will be remotely monitored and operated from a central control station.

A 124-mile LPG line from Edmonton to Hughenden, Alberta, has been proposed by Hydrocarbons Pipelines, which has applied to the province's Department of Mines and Minerals for authority to build it. The line, to handle condensate, butane and propane, would be 8⅝ in. to Rosyth and 4½ in. from Rosyth to Hughenden.

Fairway field in East Texas is getting its second major crude-oil outlet. Magnolia Pipe Line is building a 21-mile gathering and delivery system consisting of 4, 6, and 8-in. It will serve the northern end of the field and tie in near Brownsboro in Henderson County with Magnolia's existing 12-in. trunk line between Corsicana and Kilgore. Completion is slated for the end of the year. System delivery capacity has not been determined. Construction contract has been let to McVean & Barlow, Odessa, Tex., contractor. With completion of system, Mobil Oil, which owns Magnolia Pipe Line, will join Pure Oil as major purchaser of Fairway crude.

Authorization to deliver additional gas for resale in Portland, Salem, Eugene, Albany, and Springfield, Ore., has been given El Paso Natural Gas by FPC. El Paso has built 121.4 miles of 10 to 20-in. lateral line from its 26-in. main line in Cowlitz County, Washington, to serve the area.

Interstate oil pipelines took in 2.2% more money in the first three quarters of 1961 than they did a year ago. Gross revenue of 72 companies reporting to the ICC was $181,381,610. The companies handled 1,214,256,266 bbl. in the first 9 months of 1961 against 1,175,936,515 bbl. in the same months of 1960.

Kassim limits IPC's operating areas

Land held by three companies producing Iraqi oil is less than 800 sq. miles now. Move is result of IPC's failure to meet fiery premier's demands.

IRAQ'S revolutionary premier, Gen. Abdul Karim Kassim, finally dropped that other shoe he had been dangling over Iraq Petroleum Co. since October when he broke off talks with the British-American-French-owned company.

Last week the Iraqis announced they have reduced the operating areas available to less than 800 sq. miles. There is real doubt that this will cover the proved and producing fields in the country.

In October Kassim warned he was going to take drastic action to limit the activities of the three-company group which produces Iraq's oil. He insisted he had no other choice because the companies would not accede to his demands for a bigger cut of the profits, in interest in the operation, and immediate relinquishment of 90% of the concession area (OGJ, Oct. 23, p. 96).

"These are your wells," Kassim said, apparently referring to the existing fields. "You may exploit them as you wish. I am sorry to tell you we shall take over the rest of the land according to the legislation we have prepared, so that it will not be a surprise to you."

Those were almost Kassim's last words to the group of western negotiators headed by H. W. Fisher, Jersey Standard director. The IPC group left Baghdad for London and New York pretty sure what Kassim had in mind, but not certain.

Radio reports order. Late last week Radio Baghdad dispelled any doubt anyone might have had. In an official announcement the radio said the government has restricted sharply the areas in which the companies can continue to operate. The announcement said further that the companies must turn over to the government all seismic and geological information they now have on the remainder of the country.

Details of the new legislation are still lacking, but apparently Iraq has by governmental decree cut the area held by the operating companies from about 170,000 sq. miles to less than 800 sq. miles and confined future operations strictly to those established fields which are already producing oil.

Premier Kassim
. . . he warned of drastic action.

It is assumed that the remainder of Iraq will be reserved to the government and that Kassim's regime will attempt to explore and develop any potential oil area either through a national oil company or by granting concessions to someone else.

The IPC reaction was just about what could be expected. The company issued a statement in London expressing regret that Iraq had taken the action "by discriminatory legislation" and in spite of "the terms of the agreements" between the companies and the government.

"The present rights which we reserve in full are embodied in the existing concessions and agreements and these rights are capable of alteration only by agreement and not by unilateral action of any sort," the statement from IPC concluded.

What was done. Companies which own interests in the IPC group were reluctant to comment any further on the Iraqi action last week without first studying in detail the terms of Kassim's "legislation." But, according to Radio Baghdad, here is what apparently was done:

Iraq Petroleum Co., largest and oldest of the three companies has been assigned a total of only 284 sq. miles of operating area out of its original 32,000 sq. miles in Iraq. The radio reports indicate the IPC allotment is broken down into six different blocks. Kirkuk, Iraq's biggest oil field, which is more than 60 miles long and produced an average of 688,840 bbl. daily the first half of this year, was assigned only 182 sq. miles.

Bai Hassan, the only other major producing field in the IPC concession area, was given only 69 sq. miles. This field produced 45,570 bbl. daily the first half of this year. Four additional blocks totalling 33 sq. miles were allocated to IPC. These apparently are meant to cover Jambur and Butmah fields, which together produce about 23,000 bbl. daily.

Mosul Petroleum Co. was allocated only 17 sq. miles to cover Ain Zalah field, its prime producing property. Apparently this is all the company will be allowed to keep out of a concession covering 46,000 sq. miles. The Ain Zalah field produces just under 20,000 bbl. daily.

Basrah Petroleum Co. was assigned a total of 428 sq. miles to cover its two producing fields in southern Iraq. The Rumaila field was allocated 216 sq. miles and Zubair field 212 sq. miles. Together the fields produced about 191,000 bbl. daily the first 6 months of this year. They are the only producing fields in an original concession covering about 90,000 sq. miles.

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TECHNICAL SUMMARY

"DV" Multiple Stage Cementer — The depth desired for the upper cement stage determines the point at which the "DV" Multiple Stage Cementer is made up in the casing string. The lower stage of cement is pumped through the end of the string in the usual manner. At this point, an Opening Bomb is dropped to the opening sleeve seat in the "DV" tool. Applied pump pressure against this bomb moves the sleeve down, opening the cementing ports to the well bore through which the upper stage of cement is then pumped. Following cement placement, a Closing Plug is dropped down the casing to seat in the closing sleeve of the tool. Here the novel hydraulic differential principle of the "DV" tool becomes effective. Applied pump pressure moves the closing sleeve down, telescoping it into the opening sleeve, sealing off the ports. The sleeves are permanently locked together and to the lower member of the tool body, preventing them from rotating during drilling out operations. By using displacement type plugs, the upper and lower stages of cement may be pumped together, making the job a continuous operation.

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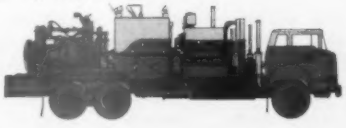

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Iran expects big things from Sarajeh

Although Iran's a top-ranking oil exporter, it has a growing problem of how to meet its own fuel needs. Sarajeh, huge gas-condensate reservoir being developed by government company, may provide solution.

Paul Swain
International Editor

IRAN is going into the gas-producing business on a big scale and is trying, at the same time, to solve one of the greatest paradoxes that plague modern Persia.

Iran has one of the biggest oil reserves in the world today. The country can also boast one of the world's rapidly expanding markets for oil products. But Iran's problem is in getting the two together.

Sarajeh field, a gas-condensate reservoir being developed by the nationally owned National Iranian Oil Co. in the central plateau area of the country, is now seen as the device to make the "twain meet."

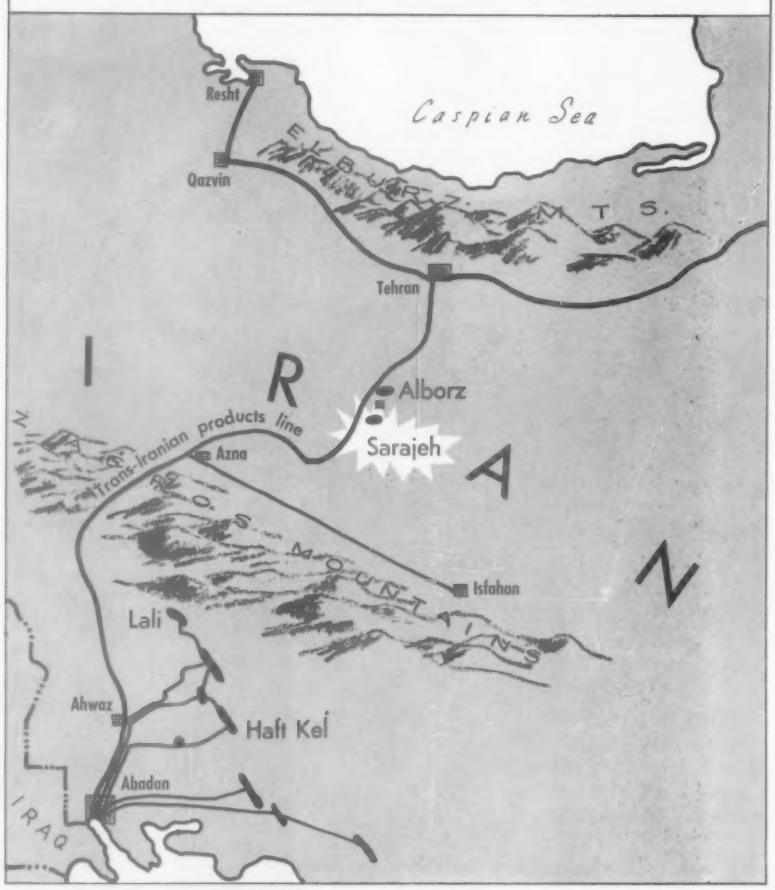
On the basis of the six wells it has completed at Sarajeh, NIOC says it has one of the major gas reserves of the world. The company plans to put it to work for Iran. NIOC says its "conservative" estimate of Sarajeh reserves is 1.5 trillion cubic feet of gas and 51.5 million barrels of condensate.

This would make Sarajeh one of the world's ranking gas reserves.

Hard-pressed for money in spite of Iran's oil revenues, NIOC has negotiated $175 million in credits from a group of West German industrialists to help bridge the gap between the country's oil resources and its consumption needs. Sarajeh and a natural-gas pipeline hold the key to the development. Also included in development plans: a refinery of still-unspecified size for Tehran, and an additional products pipeline linking the big Abadan refinery with Tehran.

Discovery of Sarajeh by the national oil company has done a lot to assuage some of the bruised nationalistic feelings in a country that has watched its prolific oil industry being operated by foreigners. Discovery of the field was only half the problem. The Iranians had to evolve a policy of making it work for them to solve some of their growing fuel needs. They hope the $175 million in credits—and the projects these credits will buy—will do just that.

Sarajeh field—Iran's bright hope



The basic problem. Completely aside from the natural pride the Iranians have in finding Sarajeh on their own, the field promises to help solve at least a part of a pressing energy problem in the country.

Iran's producing oil fields, now being operated by a consortium of western oil companies, are all located in southwestern Iran. This region is still about as backward and rural as it was 500 years ago. Tehran, the country's population and industrial center—and its prime user of energy—is almost 600 miles to the north, and that 600 miles covers some of the roughest country on the face of the earth.

Tehran's oil consumption is rising about 17% a year. The southwestern fields are now producing more than 1,000,000 bbl. of oil daily, so supply is no problem at all. But getting just the small part of the products needed in Tehran over the 600 miles that separate the capital and the refinery at Abadan is something else again.

Today all the oil products consumed in Tehran move through a

10-in. pipeline completed about 4 years ago. Capacity of the line is only about 20,000 bbl. daily and could be little more than doubled even if additional pump stations were added. This line carries no fuel oil at all and this product represents the largest volume of any consumed in the country. Fuel oil accounts for about 30% of internal Iranian consumption.

In the first 6 months of this year, the already-overtaxed railroad linking Tehran with the Southwest moved slightly more than 20,000 bbl. daily of fuel oil to the nation's capital. By 1971, NIOC estimates this demand will have increased to at least 38,000 bbl. daily and this amount couldn't be moved by the railroad.

To further complicate this problem of an oil famine within the borders of a country that stars as an oil exporter, NIOC loses money on every barrel of fuel oil it markets in Tehran.

Fuel oil sells in Tehran at a government-fixed price of about $10 a cubic meter, or roughly $1.60 a barrel. It costs NIOC another 80 cents a barrel to move it by rail, a cost that is also fixed by the government. NIOC figures it los $2.8 million marketing fuel oil in Tehran alone last year. Projections of demand for the next 10 years indicate a rather startling loss of another $80 million for NIOC if things go on as they are now.

The Sarajeh solution. These rather bleak projections for the future make Sarajeh and its gas look even more attractive to NIOC than might be the case under other circumstances. Latest estimates made by the company indicate that Sarajeh gas could replace about 5.6 million barrels, or 40% of Tehran's anticipated 1971 fuel-oil demand.

NIOC believes that the first year Sarajeh gas is available in Tehran it will replace more than 2 million barrels of fuel oil. The company also cites further advantages of less air pollution; the fact that no storage will be needed for the gas; and the fact that industrial users of the sulfur-free gas will need less maintenance of equipment.

The company concedes Sarajeh gas will never completely replace fuel oil, but NIOC points happily to the fact that it expects to save $35 million of the loss it would otherwise face in the first 10 years that the gas is used in Tehran.

Dr. A. Fallah, assistant director of NIOC's technical development and research group, estimates the construction costs of an 88-mile pipeline from Sarajeh to Iran could be amortized in less than 5 years.

The gas company. The Sarajeh gas would be made available to industrial users at first, but a distribution network is planned for residential consumers later.

A company which could undertake the gas distribution and sales was organized in Tehran months before plans for the Sarajeh pipeline were finally approved by all the necessary government councils. The company is registered as Skerkat Sahami Masraf Gas (SSMG). NIOC holds 51% of the new company. SOFREGAZ, a French firm, and SOPETROL, a Swiss concern, each have 24.5% of the new venture.

The new company was organized to undertake all the technical and economic studies needed in conjunction with industrial and commercial sales of gas "and its derivatives."

Sarajeh field. The gas-condensate field was discovered in August 1958 with a well that threatened for a time to try and duplicate NIOC's famed Alborz 5, less than 25 miles to the north, which blew wild for weeks and threw an estimated 5 million barrels of oil over a large part of the landscape before it finally bridged and shut itself in.

The incident highlighted a troubled start for Alborz field, a 30-mile-long structure only 70 miles south-southwest of Tehran.

Alborz 5 was drilling to reach the Qum limestone objective in the Alborz field when the big blowout occurred. The well had gone less than 1 foot into the limestone when it blew out August 26, 1956.

It was November 18 before the well bridged. During a prolonged period of control, it flowed through a 4-in. line at wellhead pressure of 1,800 psi. and the flow was burned away from the wellhead.

The blowout ranked as one of the most spectacular in modern drilling history.

The Sarajeh discovery almost got away, too. With only surface casing in the hole, the company started making initial tests on an Oligo-Miocene limestone topped at 7,900 ft. A geyser of gas and mud broke out of the surface almost 2 miles from the rig floor and others appeared nearer. The crew killed the well with cement.

Even now the deep well cellar fills with the blue-green, 59° condensate and must be bailed out periodically.

The second well was drilled down dip from the discovery. It tested between 300 and 400 bbl. daily of condensate with gas-oil ratios that ranged from 14,000:1 to 17,000:1.

Since that time the company has completed another five productive wells on the 30-mile-long Sarajeh structure and these wells are the basis for what NIOC calls its "conservative" estimate of 1.5 trillion cubic feet of gas.

The national company made no secret of the fact that it hoped to find an oil field at Sarajeh even after the first wells indicated it was predominantly a gas reservoir. Iranians hoped at first that those initial wells might have been drilled into the gas cap and that further down-dip drilling would find oil. But, present plans indicate that Iran isn't going to quibble. After all, who would with a gas field of that size?

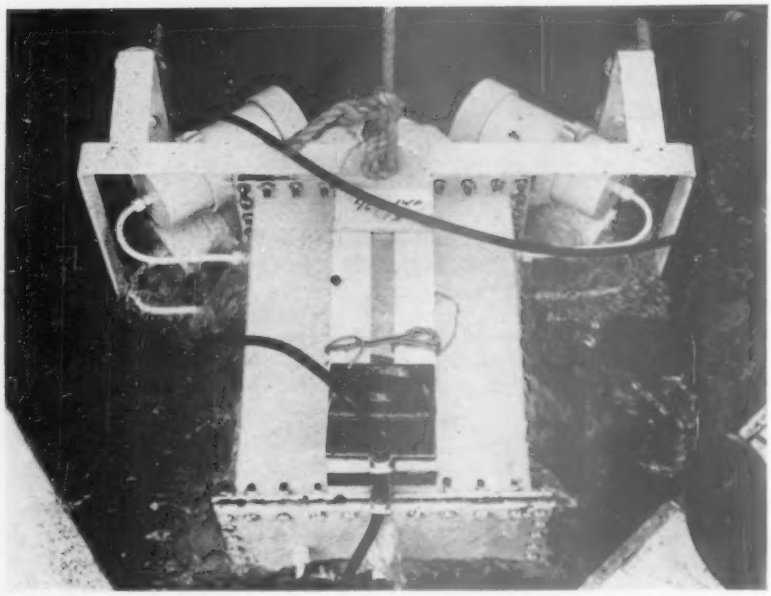
Next week:

Special world-wide report

THE trend of oil activity abroad will be packaged in The Oil and Gas Journal's annual world-wide report of December 25.

Here you will find a country-by-country statistical report on production and refining, an evaluation of the significant news, and maps of Argentina, North Africa, and the Persian Gulf.

Watch for it in next week's issue.



TV CAMERA goes under water to make inspections.

TV makes maintenance checks

SHELL Nederland is successfully using closed-circuit television to inspect submerged objects at its 300,000-bbl. Rotterdam refinery.

The camera (above), enclosed in a water-tight case, checks jetties, foundations, sheet pilings, and similar objects at depths to 50 ft.

Chief use of the system at present is to check welded joints and corrosion. Four powerful photographic lamps attached to the camera enable experts to see a situation for themselves. A filter on front of the camera lens largely eliminates the problem of light reflection.

Made by Philips Electrical, Ltd., of Eindhoven, and adapted at the refinery, the camera also may be used to check meters or equipment in high-above-ground places that are hard to reach.

Blowout in new Bolivian field ignites

GULF OIL last week was fighting a well fire in its new Caranda oil field in East Central Bolivia.

The company's Caranda 7 blew out when it hit what was believed to be a stray gas sand at 3,000 ft., several hundred feet above the oil zone found in nearby wells. Dry gas blew heavy drilling mud out of the hole and flowed for several days before igniting.

The gas flow is confined in a 9⅝-in. casing, which is cemented in the hole to a depth of 1,000 ft. Rate of flow at present cannot be determined.

Red Adair, oil-well fire fighter, has arrived on the scene to direct control operations. There were no injuries either at the time of the original blowout or when the well caught fire. A Parker Drilling Co. rig was moved off the well before the gas ignited, and is largely intact.

Caranda is about midway and slightly south of the 3A and 4 wells, which are a little more than a mile apart. Both flowed better than 1,000 bbl. daily of 52°-gravity oil on ½-in. chokes from perforations in a tertiary formation in the 3,400-to-3,600-ft. range.

The Caranda discovery, about 1½ miles southeast of 3A, tested better than 300 bbl. daily from a thin permocarboniferous sand at 5,800 ft. The second well, half a mile to the north, is the same class well as the discovery, with pay at 6,200 ft.

The No. 5 well was completed as a shallow gas well 2½ miles southeast of the discovery. No. 6 was abandoned.

Refrigerated LPG on way to Japan from new Aramco terminal

THREE industry firsts have been set with the initial shipment of 50,000 bbl. of refrigerated LPG from a new Aramco terminal on the Persian Gulf.

The cargo, now enroute to Japan, marks the:

First large commercial shipment of butane and propane under refrigeration.

Opening of the first facility specifically designed to refrigerate propane and butane for shipment by tanker.

First voyage of the Japanese tanker Gohshumaru, the first ship especially designed and built to carry refrigerated LPG.

The LPG from Ras Tanura refinery is chilled at Aramco's new $7.5-million facility, also at Ras Tanura, which cools propane by evaporation and butane by heat exchange. The liquids are stored under pressure of about ½ psi. in three insulated tanks. One holds propane, one stores butane, and the third contains mixtures of the two products.

Heating elements in the foundation of each tank keep the ground from freezing and heaving.

The initial shipment of 30,000 bbl. of propane and 20,000 bbl. of butane was piped aboard the 46,000-ton tanker through a special aluminum loading arm into five 10,000-bbl., thermos-bottle-shaped tanks installed over the vessel's keel. The butane is being shipped at 30° F., and the propane at −40° F. The ship also carries 258,000 bbl. of crude in conventional tanks installed around the LPG storage equipment.

Each 1,000 bbl. of LPG is equivalent to about 250,000 cu. ft. of atmospheric vapor. The shipment is therefore equal to about 12,500 M.c.f. The cargo is being delivered to General Gas Co. at Kawasaki, Japan, an LPG distributor in which Stanvac has 25% interest. When the break-up of Stanvac is completed in Japan by the end of this year, Stanvac's interest in General Gas will be taken over by Esso (see story, Page 63).

Stanvac will be split first in Japan

THE split up of Stanvac in Japan will be completed by the end of this year.

The company's parents, Jersey Standard and Socony Mobil, have agreed on the division of assets, and legal steps are now in the mill to assign the business to two new corporations. These are Esso Standard Sekiyu, KK, wholly owned by Jersey, and Mobil Sekiyu, KK, wholly owned by Mobil.

The breakup of Stanvac in Japan is the first major step toward dissolution of Standard Vacuum Oil Co. under terms of a consent decree signed in New York last year by Jersey Standard (OGJ, Nov. 21, 1960, p. 14). Ironically, Jersey was given 5 years to bring about the division of Stanvac's assets in Japan because of the complicated corporate relationship. The division is to be completed in other areas in 3 years. But Jersey and Mobil decided to crack the toughest nut first.

Esso will get two-thirds of Stanvac's Japanese assets and Mobil gets one-third. But the assets will not be divided across the board. Each company will have 50% interest in Stanvac's marketing business. Esso will get most of the refining assets to give it an over-all two-thirds interest in the operation.

Marketing. Esso and Mobil are dividing Stanvac's Japanese markets geographically, except in six areas of concentrated demand where the companies will compete side by side.

Esso is taking over district marketing organizations based in Sendai, Yokohama, Nagoya, Kyoto, and Hiroshima. Mobil is getting the sales groups based in Hokkaido, Tokyo, Osaka, Shikoku, and Kyushu. Both companies will operate in all of Tokyo Prefecture, Nagoya, Kobe, all of Kyoto Prefecture, all of Osaka Prefecture, and Yokohama and suburbs.

Involved are sales of 87,600 bbl. daily of products, 78,000 bbl. of which are sold directly through Stanvac outlets. This includes 15,100 bbl. daily of gasoline, 34,700 bbl. of fuel oil, 14,500 bbl. of international bunkers, and 13,700 bbl. of other products. The remaining 9,600 bbl. daily distributed by Stanvac includes a full range of products sold to wholesalers.

No abrupt replacement of trade marks or brand names will be attempted, and the transition will be carried out in an orderly manner.

Refining. Toa Nenryo Kogyo, a leading refining company with about 10% of the local market, has been reorganized with Stanvac's interest reduced from 55% to 50%. After the split up, Esso and Mobil each will have 25% interest. Toa has a 42,500-bbl. refinery at Wakayama and a 32,300-bbl. plant at Shimizu. A 31,000-bbl. plant is under construction at Kawasaki. Esso and Mobil also will have 25% interest each in a petrochemical plant Toa now has under construction at Kawasaki.

Toa also owns 60% interest in Nichimo Oil Refining Co., which has a 12,000-bbl. refinery at Kawasaki. Mobil and Esso will both have

Proposed division of Stanvac's Japanese marketing areas

Mobil will get Stanvac's outlets on Hokkaido, Kyushu, and Shikoku islands. All Stanvac outlets in Hiroshima and Sendai marketing districts go to Esso Standard. The two will divide outlets and compete against each other in Tokyo, Kyoto, and Osaka prefectures, and in Nagoya, Kobe, and Yokohama areas.

interest in this plant through their participation in Toa.

Other Stanvac holdings, however, will go entirely to Esso. This includes a 50% interest held by Stanvac in General Sekiyu, which has a 35,000-bbl. refinery at Kawasaki. The other 50% is owned by General Bussan, an independent marketer and distributor. Esso will supply crude to the General Sekiyu refinery, and General Bussan will market the products.

Esso also will acquire a 25% interest held by Stanvac in General Gas Co., an LPG distributor. The remaining 75% interest is held by General Bussan and other units of the Mitsui group, which was among numerous organizations broken up after the war.

Esso's chief representative in Japan after the split up will be J. D. Davis. Mobil's chief representative will be E. S. Checket (see Personals, p. 144).

Oil industry's capital outlay declines

CAPITAL spending in the free world dropped last year to $10.5 billion, Chase Manhattan Bank reported.

The figure, compared to $11.1 billion in 1959, pushed the industry's gross investment in fixed assets to $105 billion. In 1950 it was only $37 billion.

Last year was the third straight year the oil industry has spent more money abroad than in the U. S., but the U. S. still holds the investment edge for the past 10 years with $52 million of the $90 million outlay for replacement and expansion of property, plant, and equipment. Here are some highlights of the bank's most recent study:

Gross investment in the free world's fixed petroleum assets increased 2.8 times in the past 10-year period while production, refinery throughput, and consumption were doubling.

Production investment is the lion's share still. During the 10-year period, 57% went into production, transportation 14%, refineries and chemical plants 16%, and marketing and other facilities 13%.

Foreign fixed assets account for $47 billion of the total, and American companies contributed $17 billion of this figure.

U. S. companies accounted for 64% of the fixed petroleum assets in Venezuela, 59% in Canada, 49% in the Middle East, and 23% in western Europe.

ENI's Persian Gulf field ready to go on commercial production

ITALY'S ENI expects to produce about 15,300 bbl. daily next year from its Iranian offshore oil field at the head of the Persian Gulf.

The start of commercial production was disclosed in the state agency's report on anticipated sources of crude in 1962. Of the 8.5 million tons (about 170,000 bbl. daily) required by the ENI group next year, 9% is expected to come from its own production in Iran.

Until now, the agency has made only trial shipments from the Persian Gulf concession where it brought in a 3,500-bbl.-daily discovery last year. SIRIP, the operating company, is owned jointly by the Italians and National Iranian Oil Co.

Russia will be the largest source of ENI imports, supplying 38% or about 64,600 bbl. daily. Egyptian fields in which ENI has an interest will supply 26% or 44,300 bbl. daily, and the agency's domestic fields, 12%, or 20,300 bbl. daily. The remaining 15%, about 25,500 bbl. daily, will be purchased in the Middle East.

Foreign briefs

Construction contract for a soviet-financed 10,000-bbl. Ethiopian refinery is expected to be awarded soon by the country's Ministry of Commerce and Industry. The $12.3 million plant will be built at Assab, a port on the Red Sea.

Somalia has granted ENI a 7-year extension on its exploration concession in the northern part of the East African country. If oil is found, rights will be extended for 40 years.

Agip Mineraria Spa., a subsidiary of Italy's ENI, now holds 90.74% interest in International Egyptian Oil Co. following a takeover of shares held by Petrofina S.A. International Egyptian, in turn, holds 50.88% interest in Cie. Orientale des Petroles D'Egypte (COPE), which produces about 36,000 bbl. daily from fields in Sinai Peninsula. The Egyptian Government holds the remaining interest in COPE.

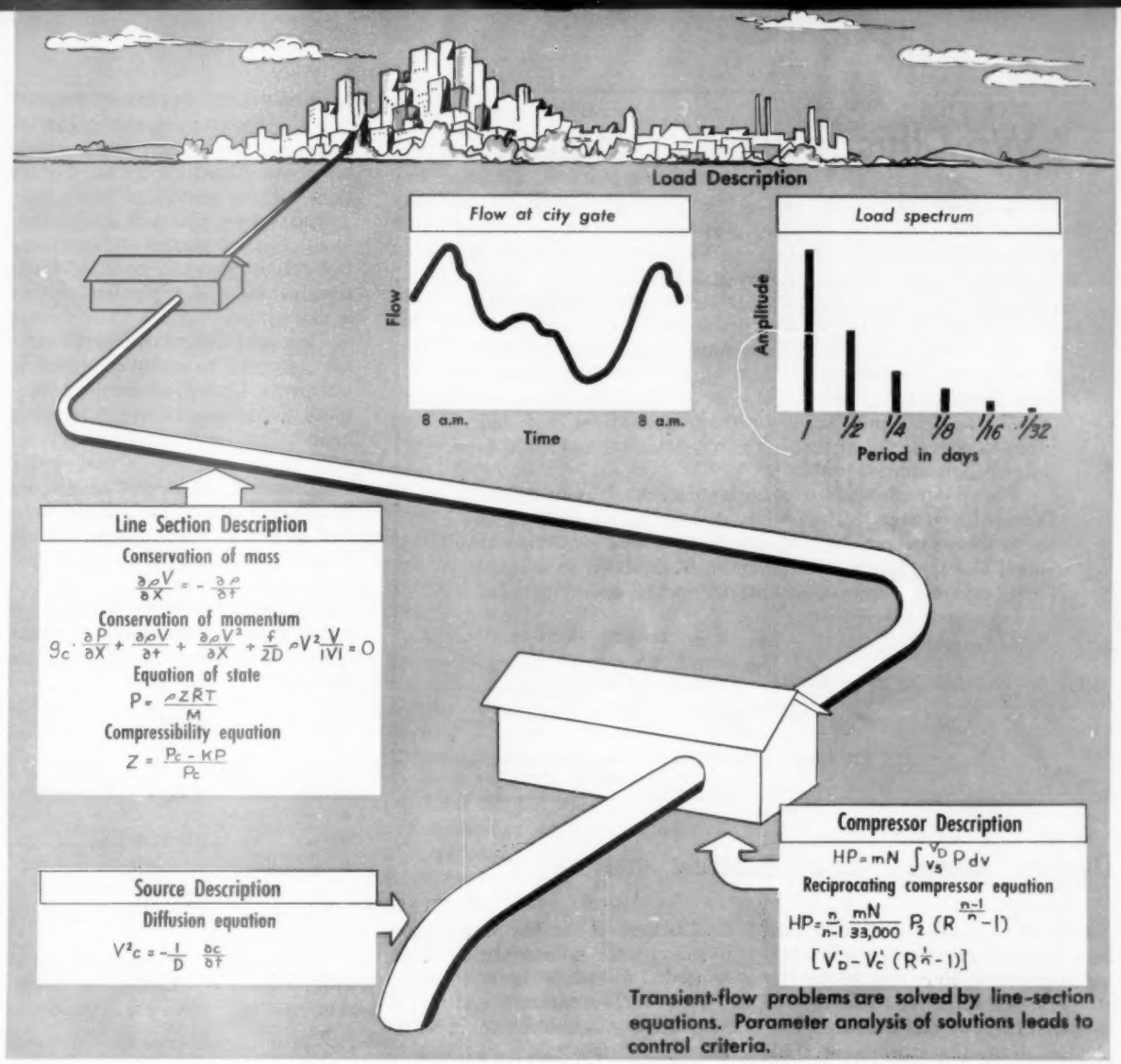
A new engineering firm, Parsons-Mitsubishi, has been formed by the Ralph M. Parsons Co. of Los Angeles and New York and Mitsubishi Chemical Manufacturing Co., Ltd., member of the Mitsubishi group in Japan. The new company has opened offices in Tokyo and will handle engineering and construction of petroleum, petrochemical, chemical, and related plants.

Russia's best well has averaged better than 17,200 bbl. daily for the past 18 months. The well, in Malgobek field northwest of Grozny, blew wild for 2 weeks in 1959 before it was brought under control.

A new refinery will be built early next year by Gulf Oil in the Netherlands. The 30,000-bbl. plant at Europoort, Rotterdam, will be Gulf's second in Europe. The first is under construction at Stigsnaes, Denmark. Most of the Netherlands plant output will supply Gulf's Dutch and Belgium markets, and the rest will be exported. Harbor facilities will include equipment for loading LPG.

Expansion of the 80-mile 6-in. Empresa Colombiana de Petroleos product and LPG line in Colombia has been started by Williams Brothers. About two-thirds of the 6-in. line will be replaced with 8-in. pipe.

Another gas find has been made in Israel's Judean Desert. Naphtha Israel's 1 Hakanaim has open-flow potential of 52 million cubic feet daily. Production is from Zohar limestone at 3,707 ft. Company plans to deepen through Zohar series before starting development.



Transient-flow problems are solved by line-section equations. Parameter analysis of solutions leads to control criteria.

DYNAMIC APPROACH TO GAS-PIPELINE ANALYSIS

promises minimum operating costs

BY E. H. BATEY,
H. R. COURTS,
AND
K. W. HANNAH

Texas Research Associates Corp.

New approach shows how to operate the pipeline for least fuel costs. Once fuel cost is known, degree of automatic control to meet this objective can be found. Comparison of equipment cost and fuel savings will give potential payout. This is the first rigorous mathematical analysis of gas-pipeline flow, both steady-state and transient.

(Article starts next page.)

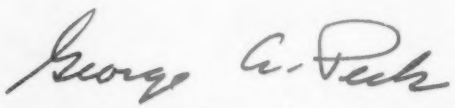
Why this research program?

A tumult of opinion among gas pipeline companies has existed for a number of years over what constitutes the ingredients of a "best" control system for a pipeline. Some of the divergence results from the physical dissimilarity of various pipelines. In spite of the physical differences, however, many of the basic control factors are common to all.

Therefore, we in the industry must either be reasoning differently from one another or else we have not been reasoning from the same basis.

The research program described in this article was undertaken to provide the factual basis from which to approach logically specific control problems.

The program was conducted under the sponsorship of Dresser Electronics, SIE Division. Its purpose—a research service to the entire pipeline industry while at the same time providing Dresser/SIE with information from which to design the "best" control equipment for cutting pipeline operating costs.



President, Dresser Electronics/SIE Division.

Dynamic approach to gas-pipeline analysis

GOOD CONTROL of gas pipelines depends on a good understanding of gas flow. Here are the results of a research program to develop a thorough physical and mathematical picture of gas flow from source to load.

Control criteria. The three control criteria which emerge from a new analysis of transient, or changing, flow are:

1. Operate the system at highest possible pressure.
2. Filter transients (minimize flow fluctuations) as near the load as possible.
3. Deliver gas at contract pressure exactly.

Each criterion tends to minimize a specific type of loss, but all three cannot always be met at the same time. Minimizing total loss is most important.

Difficulty in applying the criteria depends directly on type of flow fluctuations. If the line is operated in steady state, no automatic control is needed to meet Criteria 1 and 3.

However, automatic control is needed for optimum control of large-amplitude transients. Justification can be based solely on direct energy savings.

The control system has two features of primary interest: (1) communication requirements can be greatly reduced if set-point control is provided at compressor stations, and (2) optimum dynamic control can result from using time-variable set points based on transient solutions of flow equations.

This article discusses each phase in the development of the new control philosophy and criteria. First, **transient flow in a pipeline section** is considered.

Then **pipeline section parameters** are analyzed to completely define transients. Control philosophy combines the results of the parametric analysis and leads to specific control criteria.

Control is applied through the compressor, using pressure as control parameter. Some set points are based on transient solution and dispatcher information.

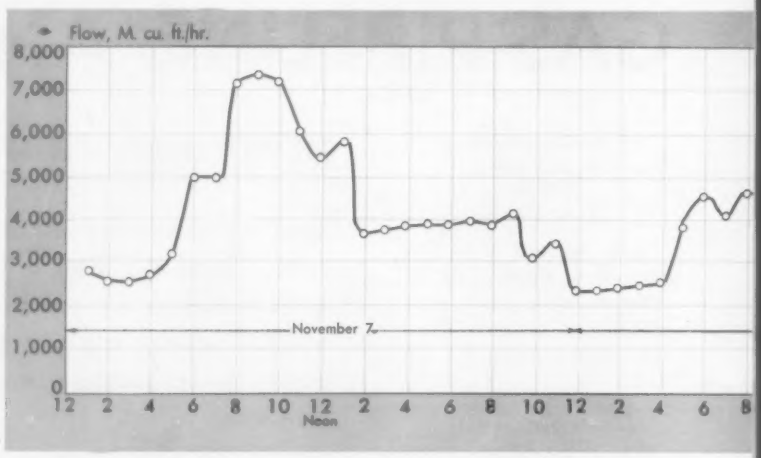
An example shows how maximum-pressure operation cuts operating costs from $196,000 to $15,000.

The over-all system

The pipeline system has four components: (1) load, (2) compressor station, (3) line section, and (4) source. An understanding of gas flow in the pipeline complex is possible when flow can be described in physical and mathematical terms for each component.

Two components, line section and compressor, are treated in detail. The other two are considered briefly.

Source. "The diffusion equation" governs flow from a gas-bearing formation. Almost always, flow is further restricted by legal, conservation, and other requirements. A gathering system may range from simple sin-



FLOW VARIATIONS at the Denver city gate. The wide variation and cyclic pattern is typical of a predominantly residential load. Fig. 1.

gle-well flow to an extremely complex combination of sources and may vitally interest an operating company.

The techniques outlined here are able to describe upset propagation introduced by source variations. However, source-complex manipulation is outside the scope of this report.

A "sufficient" supply of gas is assumed available at all times.

Load determines the control-problem complexity. Load is time rate of gas delivery to a customer. Some of the different loads are: residential, commercial, deliveries to another pipeline, deliveries to a storage field, etc.

Normally, the transmission company is not able to dictate customer gas demands. Contracts usually state that a minimum discharge pressure be maintained. The user directly determines gas quantity as a function of time. Sometimes limits are placed on the total amount taken in some given unit of time.

Time-dependent behavior of the load is the most important factor in establishing system dynamics. The load comprises the independent forcing function for the dynamics of the system.

Hourly logs of flow to Denver for a 3-day period were obtained from Colorado Interstate Gas Co., Fig. 1.

Sampling theory says recorded data can yield information down to frequencies with periods twice the sampling period. Here sampling was hourly so periods of 2 hours could be resolved. Amplitude coefficients of the Fourier spectral analysis are shown, Fig. 2.

The line section

Proper control depends on full understanding of transient flow. Pressures and flows vary with time throughout an operating gas-transmission system. These variations are the disturbances within the system. The transient solution for the pipeline section finds how these disturbances propagate.

A gas-transmission system has two classes of disturbances: those generated by load fluctuations and those generated by varying the power input.

Disturbances of the first class must be controlled by generating appropriate disturbances of the second class. An understanding of transient gas flow is required to do this.

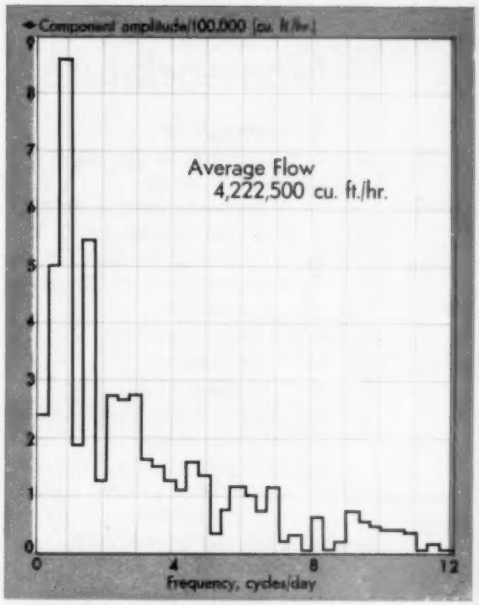
Define a pipeline section as a section of pipe with only one input and one output. Any complex pipeline network is built up of combinations of pipeline sections. Flow description in any complex system can be synthesized from flow description of a simple line section.

Solution key is judicious choice of conservation equations. Three conservation equations are applicable:

1. Conservation of mass.
2. Conservation of momentum.
3. Conservation of energy.

Simultaneous application of both 2 and 3 is not necessary. Conservation of momentum yields a simpler analysis than a conservation of energy approach.

Gas within the pipeline section is defined as the thermodynamic system to be considered. Then the system can exchange mass and momentum with the universe at only two points—input and output. It can exchange energy through heat transfer at any point along the pipeline section.



AMPLITUDE OF COMPONENTS of Fourier series expansion of the load curve shown in Fig. 1. Fig. 2.

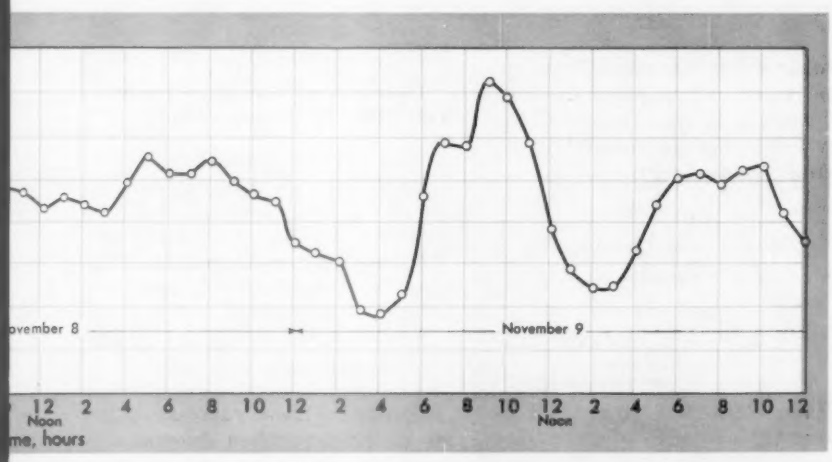
Direct application of conservation of energy requires the accounting for all the heat transfer between the system and the ground. Any solution obtained this way will require rather gross approximations.

Difficulties are avoided by a slight but decisive change of attack. Conservation of energy need not be applied directly.

Rather, specify the temperature distribution along the pipeline section. Direct application of conservation of energy is replaced by applying a holonomic constraint.[1] Energy is still conserved, but is no longer involved in problem formulation—nor obtained directly in problem solution.

Temperature and elevation profiles. Gas expansion within the pipeline section must be considered to pick a temperature profile.

Gas temperature is near ground temperature except close to the discharge side of a compressor station because flow is always turbulent and pressure gradient small. Specifying a constant gas temperature is convenient, since this is the most typical temperature profile which can be chosen. A specific pipeline sec-



Nomenclature

W = work, ft.-lb.
P = pressure, lb. per sq. ft.
v = volume, cu. ft.
v_D = discharge volume, cu. ft.
v_s = suction volume, cu. ft.
P_D = discharge pressure, lb. per sq. ft.
P_s = suction pressure, lb. per sq. ft.
n = gas constant
R = compression ratio
HP = horsepower
m = mechanical efficiency
N = speed of a compressor, r.p.m.
T′ = torque, ft.-lb.
v_d' = displacement volume, cu. ft.
v_c' = clearance volume, cu. ft.
K′ = a conversion constant to allow Q to be expressed in M.M.c.f.d.
Q = flow, M.M.c.f.d.
R = universal gas constant
T_s = suction temperature, °R.
M = molecular weight
K = the slope of a graph of Z vs. reduced pressure
p_c = critical pressure, lb. per sq. ft.
ρ = density, lb. per cu. ft.
V = velocity of gas, ft. per sec.
x = position coordinate, ft.
t = time, sec.
l w = frictional energy loss per unit mass, ft.-lb. per lb.
f = Moody friction factor
L = length, ft.
D = diameter of pipe, ft.
g_c = acceleration of gravity, ft. per sec. per sec.
E = energy lost in traveling the distance dx, ft.-lb.
F_f = force due to friction, lb.
F_p = force due to the pressure gradient, lb.
A = cross-sectional area of the pipe, sq. ft.
Z = compressibility
T = temperature, °R.
B = a constant of integration, Equation 11
ρ_s = density at standard conditions, lb. per cu. ft.
V_s = velocity of sound in the gas, ft. per sec.
K″ = a constant associated with Equation 14
Q_o = flow out of a pipeline section, M.M.c.f.d.
Q_{ss} = steady or average part of flow, M.M.c.f.d.
Q_t = amplitude of the time variable part of the flow out of a pipeline section, M.M.c.f.d.
T″ = period of the time variable output flow
Q_i = flow into a pipeline section, M.M.c.f.d.
Q_n = amplitude at the input of the nth harmonic of the fundamental period
τ_y = delay time for the yth harmonic

tion might require use of a nonconstant temperature profile.

Elevation profile must be specified to determine a unique solution to the transient-flow problem. The following analysis had a constant elevation profile. However, nonconstant elevation profiles can be treated.

First equation. The continuity equation states that net mass rate of flow out of a volume equals the rate of mass decrease within the volume. This conservation of mass, expressed for a pipe of constant cross-sectional area, is:

$$\frac{\partial \rho V}{\partial x} = - \frac{\partial \rho}{\partial t} \qquad (1)$$

Second equation. The conservation of momentum theorem states that net force acting on the fluid within a control volume equals time rate of change of momentum within the control volume plus net outgoing momentum flux.[2] Define a "control volume" as a volume, fixed in space, through which fluid flows. It has length dx and cross-sectional area A.

An additional force results from considering nonhorizontal flow—a force related to static pressure head. It could be treated in a specific system but is omitted here.

The net force for horizontal flow acting on the gas in the control volume is the sum of forces due to pressure gradient and friction. Friction force is found from the expression for frictional energy loss per unit mass:[3]

$$l w = \frac{f V^2 L}{2 D g_c} \qquad (2)$$

Mass within the control volume is ρ (A dx), and length of the control volume is dx. Therefore, energy lost by the gas in traveling the control volume length is:

$$E = \frac{f V^2}{2 D g_c} \rho \, (A \, dx)$$

$$\times \, dx \frac{V}{|V|} = - F_f \, dx \qquad (3)$$

Ratio V/|V| was inserted to change the sign of F_f when velocity direction reverses. The last expression in Equation 3 equates the energy lost to a frictional force, F_f, times the distance, dx. The negative sign indicates the direction of F_f opposite to V. Then:

$$F_f = - \frac{f V^2}{2 D g_c} \rho \, (A \, dx) \frac{V}{|V|} \qquad (4)$$

Force due to the pressure gradient, F_P, is:

$$F_P = - \frac{\partial P}{\partial x} (A \, dx) \qquad (5)$$

Time rate of change of momentum within the control volume is:

$$\frac{1}{g_c} \frac{\partial \rho V}{\partial t} (A \, dx) \qquad (6)$$

Net outgoing momentum flux is:

$$\frac{1}{g_c} \frac{\partial \rho V^2}{\partial x} (A \, dx) \qquad (7)$$

Combining these expressions by use of the momentum theorem:

$$g_c \frac{\partial P}{\partial x} + \frac{\partial \rho V}{\partial t}$$

$$+ \frac{\partial \rho V^2}{\partial x} + \frac{f \rho V^2}{2D} \frac{V}{|V|} = 0 \quad (8)$$

Equations 1 and 8 are two simultaneous partial differential equations with two independent variables, positions and time, and three dependent variables, pressure, density, and velocity.

Third equation - equation of state can take many forms, depending on the system to which it is applied. The form chosen is:

$$P = \frac{\rho Z R T}{M} \quad (9)$$

Fourth equation - compressibility as a function of pressure and temperature will make Equation 9 as accurate as desired.

Between 0 and 1,000 psia., compressibility of natural gas is a linear function of pressure.[3]

$$Z = 1 - (K/p_c) P \quad (10)$$

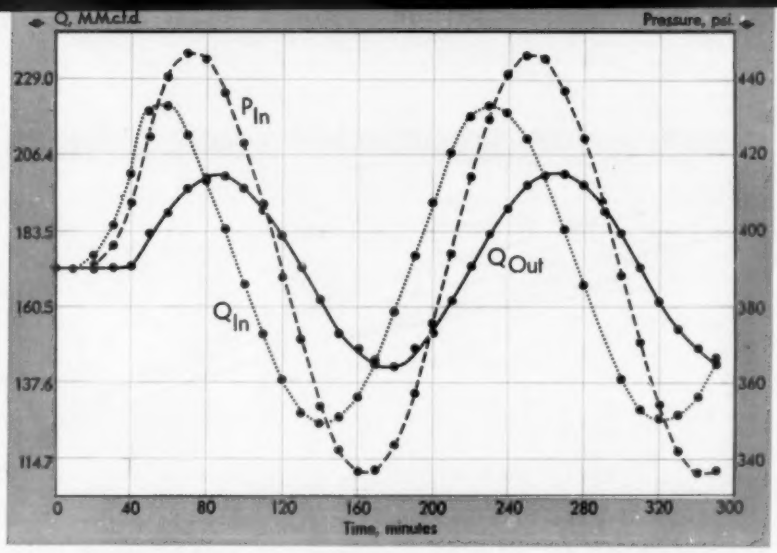
Transient gas flow is found by solution of Equations 1, 8, 9, and 10. Numerical techniques were used to obtain the solution because of the nonlinear form of the equations. Boundary conditions must be specified to find a specific solution.

First, the system's initial condition must be specified which will resolve initial velocity and density as a function of position along the pipe.

Second, two time variable boundary conditions must be specified to find a unique solution. Time variable boundary conditions have six possibilities: input pressure, input Q (flow), input velocity, output pressure, output Q (flow), and output velocity.

These quantities are not mathematically independent. A unique solution to transient flow needs only two quantities specified as functions of time. The other four quantities are uniquely determined as functions of time by Equations 1, 8, 9, and 10.

Transient-flow equations are useful only when the mathematical solution is physically significant. Physically impossible solutions do exist. An example is one requiring a negative density which indicates the specified boundary condition is not physically possible.



VARIABLE RELATIONSHIPS for a given line section. Parametric characteristics of the line section are given in Table 1. Fig. 3.

The form of suitable numerical analysis depends on the choice of time variable boundary conditions and may be divided into two classes.

1. Both time variable boundary conditions may be specified at the same end of the pipe, either input or output. In this case, numerical-analysis form is such that calculations are made away from the boundary, backward in time.

Thus, value of specified boundary conditions at time T_2 are used to calculate the pressure and flow value at the pipe's opposite end at time T_1 earlier than time T_2. Pressure and flow calculation is not possible at the pipe's opposite end at time T_2 by using the boundary condition value at time T_2.

The method of solution requirement is very important, but not obvious.

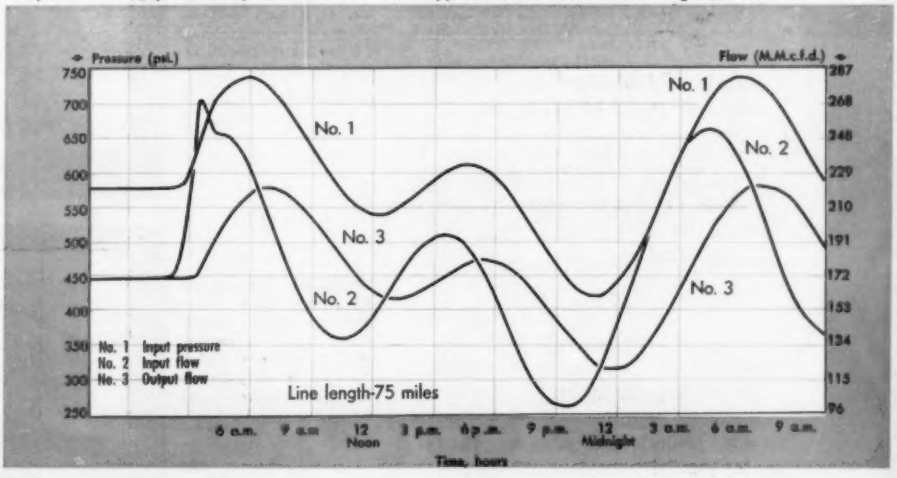
2. One - time variable boundary condition may be specified at each end of the pipe. New numerical analysis uses the two end-point boundary conditions to find pressure and flow along the pipeline section. Calculations are not made backward in time.

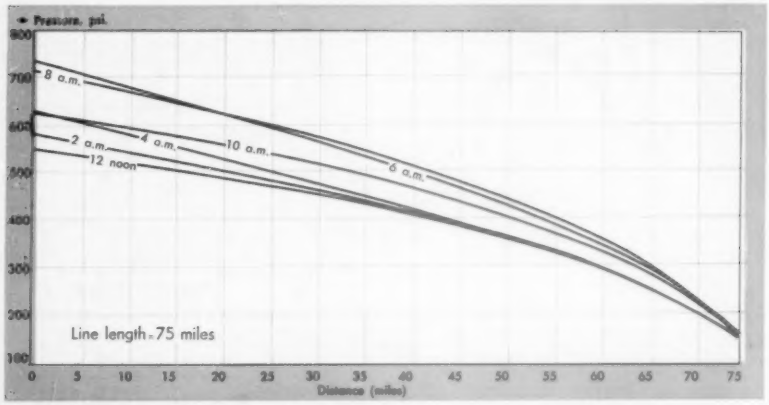
Numerical analysis was developed during the transient-flow studies for both types of boundary conditions; however, details are not included here.

A specific transient solution is shown, Fig. 3. Gas characteristics and boundary conditions are in Table 1. Line section was initially in steady state. Then, output flow was specified to begin varying sinusoidally at time t = 40 minutes.

Period of the output flow boundary condition was 3 hours. Calcu-

VARIABLE RELATIONSHIPS for a line section 75 miles long. This double frequency upset is a simplified representation of the typical residential load. Fig. 4.





PRESSURE PROFILES for line section 75 miles long. Line pack computed for the transient is different for each time of day. Fig. 5.

lated input flow function, Fig. 3, leads the output flow function in time. Peak flow occurs at input, before peak flow occurs at output which shows the need for backward calculation in time. Also, input-flow function amplitude is larger than the output flow function because input flow function attenuates as it propagates from input to output.

Table 1

Line geometry
- Length = 30 miles
- Diameter = 20 in.
- Friction factor = 0.011

Gas characteristics
- Average molecular weight = 18.652
- Slope of compressibility vs. reduced pressure = 0.134
- Pseudocritical pressure = 670 psia.

Operating conditions
- Gas temperature = 520° R.
- Output pressure = 150 psia.
- Output flow = $Q_{ss} + Q_t \sin(2\pi t/T)$

Q_{ss} = 172 M.M.c.f.
Q_t = 28.66 M.M.c.f.

Another specific solution is shown, Fig. 4. Here, line length was 75 miles. Output pressure was specified to be 150 psia. Output flow was specified as:

$$Q_o = 172 + 28.66 \times [\sin(2\pi t/24) + \sin(2\pi t/12)]$$

in M.M.c.f.d.

This boundary condition approximates the daily residential load function. Characteristic displays are peak flow in morning and evening with minimum flow at midday and midnight.

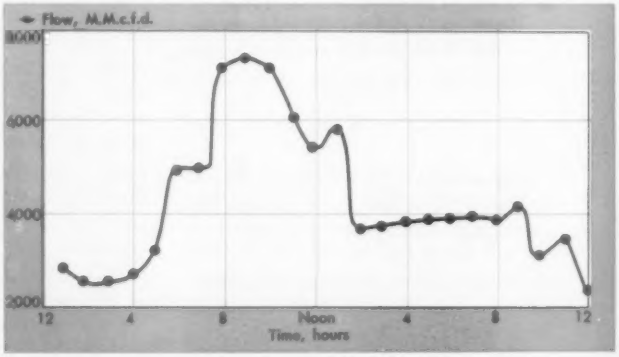
Pressure profile, Fig. 5, at 2 a.m. is initial steady-state profile. Line pack for an ideal gas is, at any specific time, proportional to the area under the pressure-profile curve.

A comparison of the 4 a.m. and 10 a.m. curves shows input and output pressures are the same, yet line pack is quite different. This shows how errors can result from use of steady-state line pack equations to a line which is not in steady state.

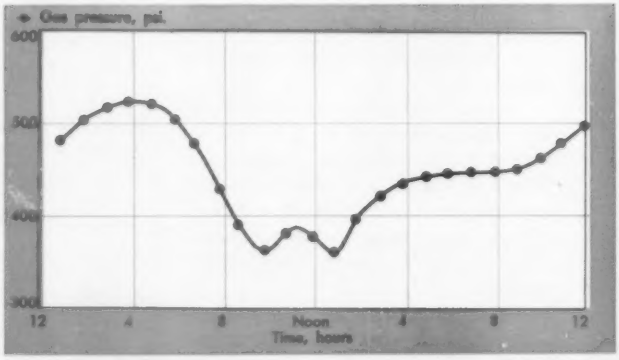
Application of transient solution to an operating pipeline was done to demonstrate the accuracy of the transient solution. These data, logged during a dynamic system upset of a Colorado Interstate line, were used as follows:

1. A specific pipeline section was selected. Its length and diameter were determined.

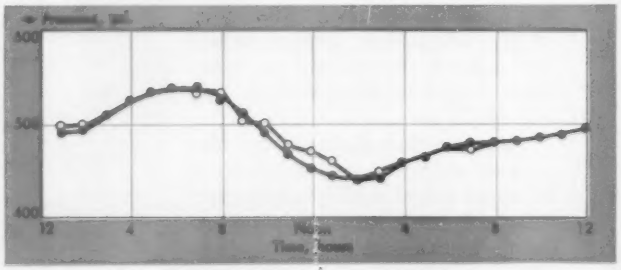
2. Boundary conditions of output Q and P were specified and were logged at 1-hour intervals over a 24-hour period.



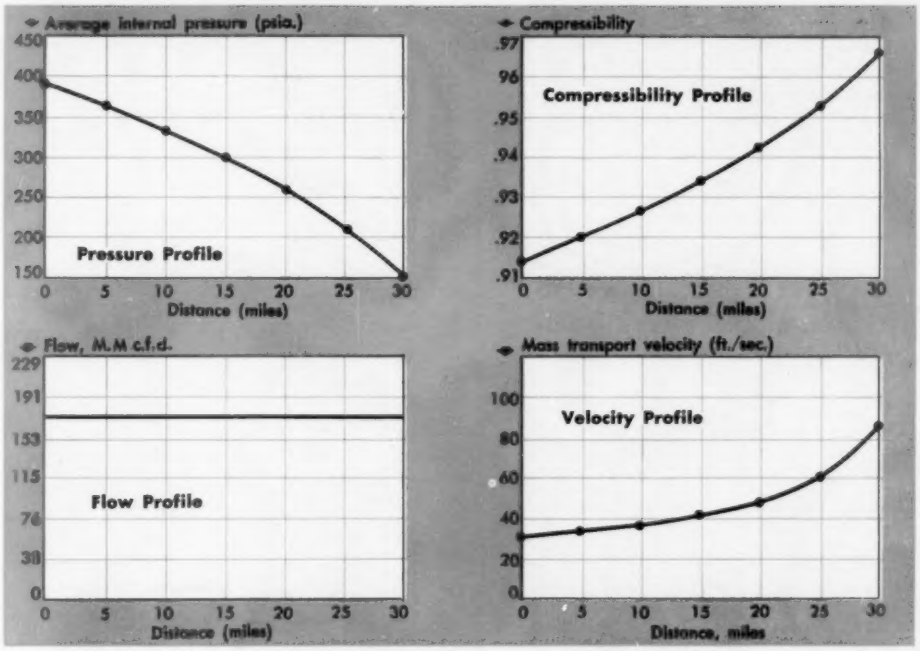
NUMERICAL comparisons were made of data taken over 24-hour period at the Denver city gate. Fig. 6.



PRESSURE variations at same point where flow shown in Fig. 6 was measured. Note the typical out-of-phase relationship between pressure and flow. Fig. 7.



PRESSURE variations 48 miles from Denver city gate. Solid-point curve is measured; open-point curve is calculated for measurements at city gate. Fig. 8.



STEADY - STATE profiles of pressure, compressibility, flow, and velocity for a given line section. Fig. 9.

3. Transient solution was used to calculate input P and Q.

4. Calculated input pressure was compared with logged input pressure for discrepancies, Figs. 6, 7, and 8.

Line section parameters were: length = 48 miles, diameter = 22 in., and friction factor = 0.00925. A comparison of calculated and logged input pressure shows satisfactory agreement.

Steady - state analytical solutions are possible with the equations now derived. A solution for the line section may be resolved:

$$x = \frac{2D}{f}\left\{\ln \rho - \frac{g_c p_c^2 M}{Q^2 K^2 R T}\left[\frac{M p_c}{M p_c + KRT\rho} + \ln (M p_c + KRT\rho)\right] - \frac{B}{Q^2}\right\} \quad (11)$$

where B is a constant, evaluated at $x = 0$. No simple form of the solution can be found giving ρ in terms of x because of the equation's transcendental character. However, the solution is completely adequate for generating a ρ vs. x plot, or any of the transmission profiles of Fig. 9.

Exact solution is compared to a commonly-used approximation. The Panhandle Eastern equation, a familiar and much simpler form of steady - state solution, is demonstrated as a good first-order approximation to Equation 11.

Original differential equations for steady-state and equation of state are combined and arranged:

$$\frac{\partial P^2}{\partial x} + \frac{\rho_s^2 Z V_s^2}{A^2 D g_c^2} \times \frac{f Q^2}{[1 - (V/V_s)^2 (1/Z)]} = 0 \quad (12)$$

Nonconstant terms in the right-hand figure of the equation are:

$$[1 - V^2/Z (V_s)^2] \text{ and } Z$$

The term $[1 - V^2/Z (V_s)^2]$ ranges from 0.99 to 1 for most pipelines. Compressibility, Z, varies over a range of about 8%. However, a mean value of Z reduces the error to the order of 4%.

The simplified steady-state solution that follows is:

$$P^2_{out} - P^2_{in} = \left[\frac{\mathbf{Z} V_s^2}{g_c^2 DA^2} \frac{f Q^2}{(1 - V^2/V_s^2)}\right] \times (x_{out} - x_{in}) \quad (13)$$

where bold faces on the terms indicate mean values.

This form is identical to the familiar form.

$$P^2_{out} - P^2_{in} = K'' x \quad (14)$$

where K'' is the bracketed constant, and $x_{in} = 0$. Thus, the Panhandle Eastern equation is seen as an approximate form of the exact steady-state solution.

Parameter analysis

The transient solution was obtained by numerical analysis of equations descriptive of the system. One way to use transient solution for control would be to apply the numerical solution directly to the transmission system.

A digital computer with associated telemetry and communication system could do the job. Unfortunately, both are very expensive and sometimes unreliable.

Possibly a better way is to use the method of parametric analysis. The essential steps are:

1. Obtain many specific solutions for different operating conditions. (A digital computer is useful here.) Assumed operating conditions should be varied over the range commonly encountered in transmission system operation.

2. Reduce the result to a suitable set of tables and graphs which can be applied to all systems.

Parametric analysis will thus change the form of the transient solution. The resulting set of tables and graphs is the transient solution. A digital computer is no longer needed.

The tables and graphs can be used either directly or as foundation for design of a relatively simple analog controller. The over-all result is a decrease in cost and complexity of control equipment.

Parametric analysis requires selecting type of transient. First the functional form of the type of transient to be studied must be selected. Any periodic function encountered in a pipeline can be expressed as the sum of a group of sine waves by use of Fourier series.

If analysis can find how all sine waves propagate in the pipeline system, then it also tells how **any** periodic disturbance propagates.

Gas delivery to the sales point at contact pressure is desirable. How can a time variable load be supplied at a constant or contract pressure? To answer this question, the output pressure as a boundary condition is specified to be a constant. Parametric analysis boundary conditions are:

1. Load will have the functional form:

$$Q_o = Q_{ss} + Q_t \sin (2\pi t/T'') \quad (15)$$

This form allows convenient use of Fourier series expansion.

2. Load pressure will be specified as a constant or contract pressure. This choice permits finding how to eliminate excessive compression-energy loss.

Amplitude vs. period graphs are a convenient method to express solution results. In general, the functional form of the input Q which results from the output boundary condition is:

$$Q_i = Q_{ss} + Q_1 \times \sin (2\pi/T'') (t + \tau_1) + \sum_{y=2} Q_y \times \sin (2\pi y/T'') (t + \tau_y) \quad (16)$$

The pipeline equations are nonlinear. Thus, calculated input functions will contain terms having frequency content higher than the original wave. However, amplitude of harmonic terms are very small compared to the fundamental amplitude.

Amplitude Q_y is less than 1% of amplitude Q_1 in most cases. This simplifies the problem:

$$Q_i = Q_{ss} + Q_1 \times \sin (2\pi/T'') (t + \tau_1) \quad (17)$$

Here Q_1 is the sine wave amplitude at input of the pipeline section; τ_1 is the time required for the sine wave to propagate from input to output. Values of Q_t/Q_1 and τ_1 are needed to specify how the sine wave propagates in the pipeline system.

Three types of pipeline section parameters are:

1. Parameters dependent on line section geometry: length, diameter, and relative roughness,[3] ϵ/D.

2. Parameters dependent on gas characteristics: molecular weight, slope of compressibility vs. reduced pressure, and pseudocritical pressure of the gas.

3. Parameters dependent on the average conditions of the pipeline section: average line pressure, average flow, and gas temperature.

Results of parameter analysis are shown here. Pipeline characteristics and standard operating conditions listed, Table 1, are applicable to all curves shown unless specific conditions are noted on the curves.

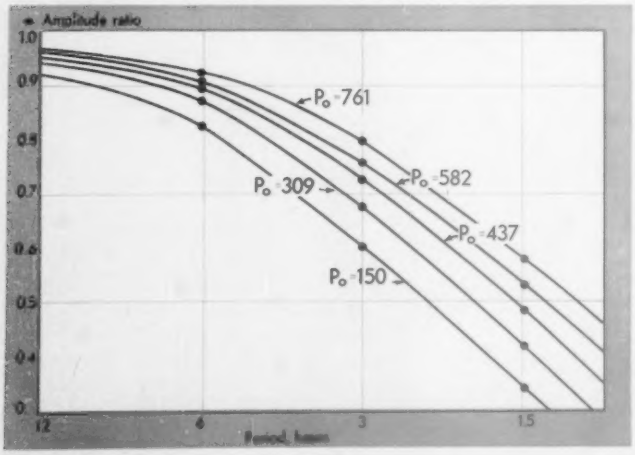
Output pressure was varied parametrically. The amplitude ratio, Q_t/Q_i, as a function of the period of the time variable is shown, Fig. 10. Amplitude ratio is less than 1, which indicates signal amplitude at the input is larger than amplitude at output. Also, amplitude ratio decreases for high frequencies, indicating that attenuation increases with frequency.

Attenuation of a specific frequency decreases as the pressure increases and is explained by considering the energy loss within the pipeline system. Energy loss is proportional to the velocity squared. Attenuation results from this energy loss. If the energy loss decreases then the attenuation decreases. Average velocity decreases as the pressure increases when average flow is held constant (172 M.M.c.f.d.)

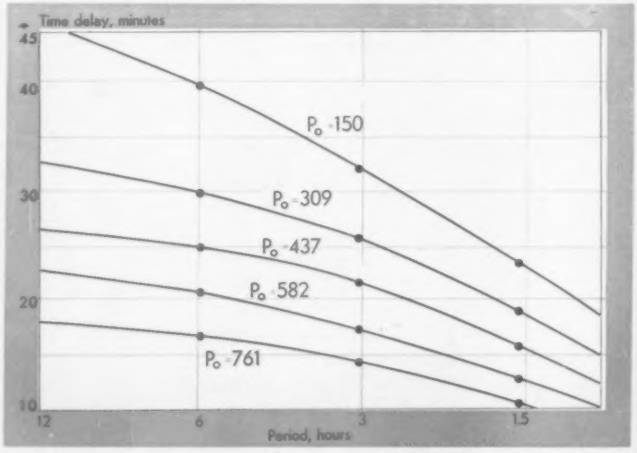
Delay time varies from 10 to 40 minutes, Fig. 11, and corresponds to a propagation velocity ranging from 180 to 45 m.p.h. Time delays of Fig. 11 are associated with amplitude ratios of Fig. 10. In general, propagation velocity increases both with pressure and frequency.

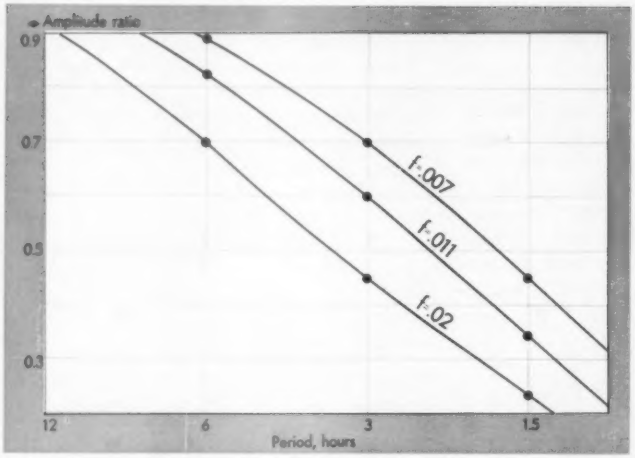
Friction factor, f, was varied, Fig. 12. Energy loss is propagational to the frictional factor. Attenuation of

OUTPUT PRESSURE was varied parametrically to find amplitude ratio of input upset to output upset, as a function of the period of the upset. **Fig. 10.**

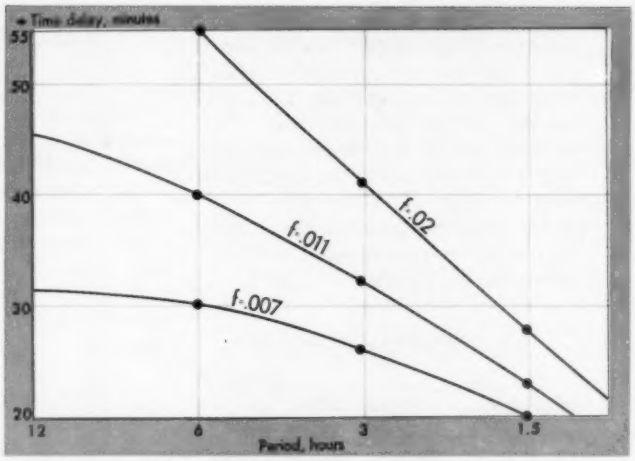


OUTPUT PRESSURE was varied parametrically to find the time delay of upset propagation from one end to the other of a line section, as function of the period. **Fig. 11.**

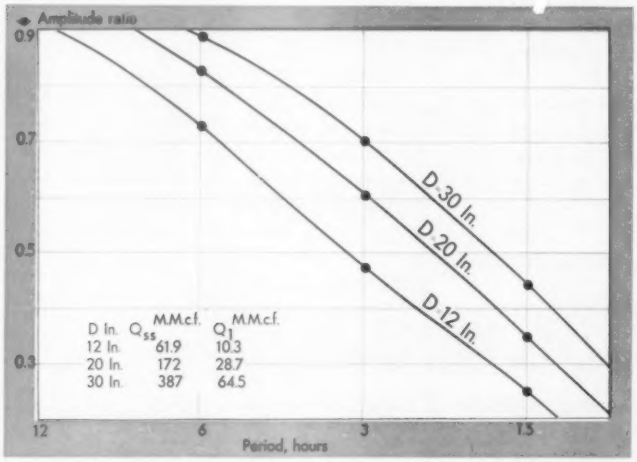




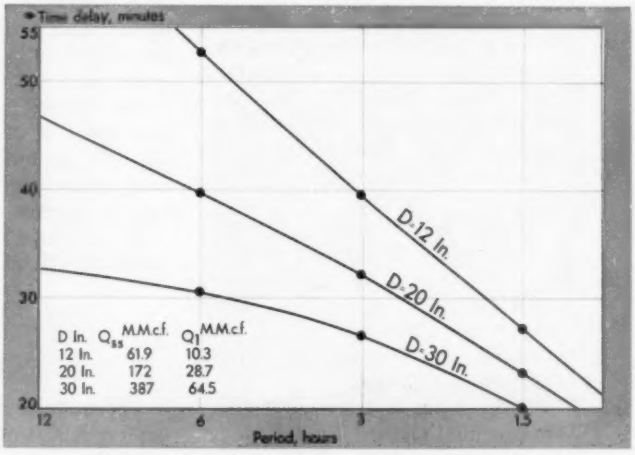
FRICTION FACTOR was varied parametrically to find amplitude ratio of the input upset to output upset, as function of the period of the upset. Fig. 12.



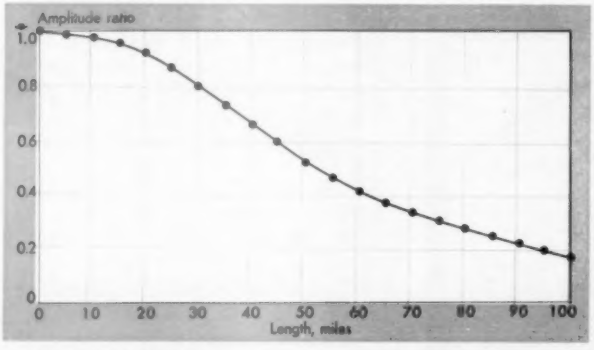
FRICTION FACTOR was varied parametrically to find the time delay the upset propagation from one end to the other, as function of the period. Fig. 13.



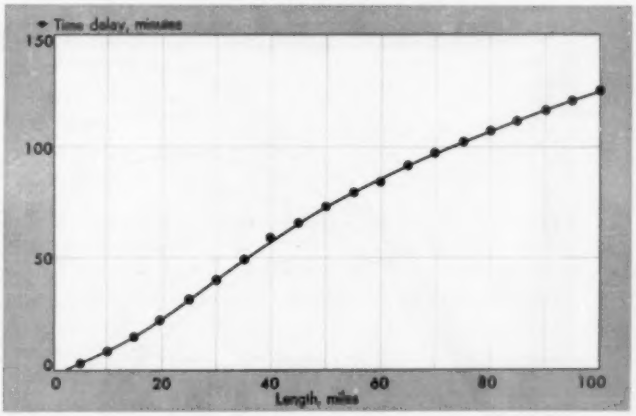
LINE DIAMETER was varied parametrically to find amplitude ratio of the input upset to output upset, as function of the period. Fig. 14.



LINE DIAMETER was varied parametrically to find the time delay of upset propagation from one to the other, as function of the period. Fig. 15.



AMPLITUDE RATIO, input upset amplitude divided into amplitude at given distance from the upset input. Fig. 16.



TIME DELAY of the propagation of an upset from input to given distance. Fig. 17.

a specific frequency increases as the friction factor increases. Time delays of Fig. 13 are associated with the amplitude ratios of Fig. 12.

Diameter was varied, Fig. 14. Flow for each diameter was different because cross-sectional area varies with diameter. Flow per unit cross-sectional area or flow density was held constant. Time delays of Fig. 15 are associated with the amplitude ratios of Fig. 14.

Length effect is shown, Fig. 16. Position is measured from the output. The line section is 100 miles long and had a signal with a 6-hour period. Output pressure was held constant at 150 psia. Delay times of Fig. 17 correspond to the amplitude ratios of Fig. 16. Delay time $\tau(x)$ is the time required for the signal to propagate from position x to the output of the pipeline section.

The compressor station

The compressor station is the control element.

Power input to the gas stream is the basic variable which can be used for pipeline control. This holds regardless of the type of equipment or specific type of control.

Four types of energy must be considered as gas flows through a compressor station—kinetic energy, potential energy of position, frictional and heat flow energy, and pressure potential energy. Total energy input is the sum of the changes of each type.

Pressure potential energy change produced by the compressor is much larger than kinetic or position potential energy changes. Also, heat transfer and frictional effects are very small compared to pressure potential energy change.

Energy input is essentially pressure potential change. Energy input of a compressor station is found by simple thermodynamic considerations.

$$W = -\int_{V_s}^{V_D} P dv \qquad (18)$$

Compression in most modern compressors very closely follows that of adiabat, $P v^n = C$, where n is the experimental constant associated with the particular gas and must be less than the ratio of specific heats of the gas and greater than 1.0. For natural gas, n varies from about 1.20 to 1.30. C is a constant.

$$W = [n/(n-1)]\, P_D v_D \times [R^{(1-n)/n} - 1] \qquad (19)$$

The equation uses only operational parameters independent of station configuration. Thus it applies to any station. A benefit is to apply the equation to specific compressors.

Two types of compressors and four types of drives are in general use. All combinations of drive and compressor have been used at one time or another.

Energy equation is simple if torque CAN be measured directly.

$$HP = \frac{m\,N\,T'}{5{,}252} \qquad (20)$$

The most widely used drive unit-compressor combination is the angle drive unit, where a compressor piston and power piston rod to the same crankshaft journal. Thus, no direct method of measuring torque is available.

The same consideration that yielded Equation 18 are applied to a compressor cylinder, and solved in terms of pocket clearance, displacement, and the other parameters:

$$W = \frac{n}{n-1} P_s [R^{(n-1)/n} - 1] \times [v_d' - v_c'(R^{1/n} - 1)] \qquad (21)$$

Work for each compressor is obtained by adding the work for each cylinder, (k):

$$W_T = \frac{n}{n-1} P_s [R^{(n-1)/n} - 1] \times \sum^{k} [v_{dk}' - v_{ck}'(R^{1/n} - 1)] \qquad (22)$$

Further, if different clearance pocket sizes exist for different cylinders, the appropriate values of v_c for each term must be used. Total horsepower input can be found by multiplying Equation 22 by the speed-N, a factor for mechanical transfer efficiency-m, and a units conversion factor.

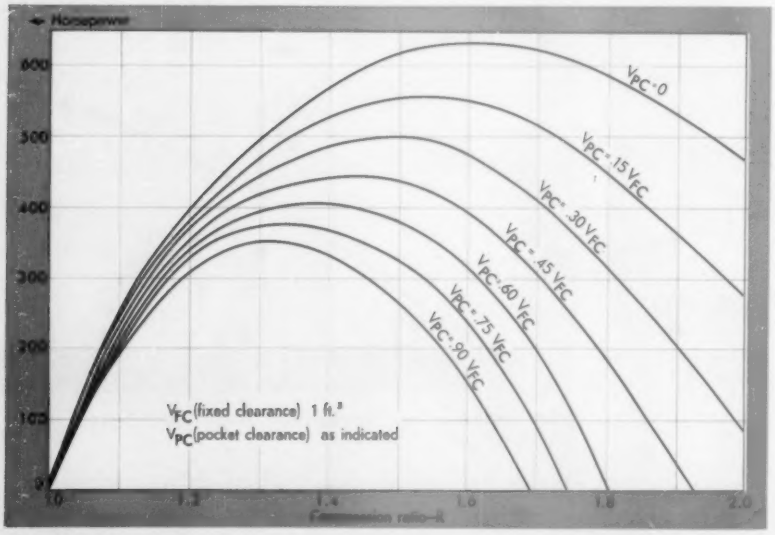
$$HP = \frac{n}{n-1} m\,N \frac{1}{33{,}000} \times P_s [R^{(n-1)/n} - 1] \times \sum^{k} [v_{dk}' - v_{ck}'(R^{1/n} - 1)] \qquad (23)$$

An alternate form of the equation expresses results in terms of parameters Q and P—the flow and pressure. Compressor horsepower equation as a function of these two variables plus the other "mechanical" factor is:

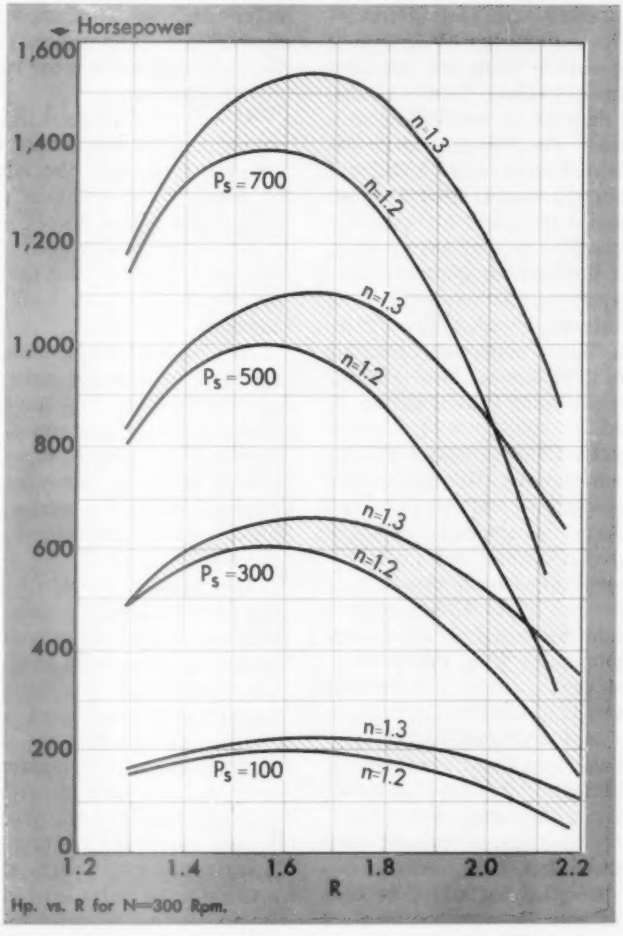
$$HP = \frac{K'}{33{,}000} \times \frac{n}{n-1} m\,Q \frac{\mathbf{R}\,T_s}{m} \times (1 - k\,P_s/P_c)(R^{(n-1)/n} - 1) \qquad (24)$$

Three compression parameters of most interest are: compression ratio, gas constant, and clearance volume, Figs. 18 and 19. An examination of Equation 23 reveals that P_s, N, and m are essentially "scaling factors."

Horsepower curves must all pass through zero when the compression ratio is 1, since no compression occurs, Fig. 18. Curves also pass



HORSEPOWER VARIATION with compression ratio and varying pocket clearance. Condition: speed = 300 r.p.m., n = 1.25, and P_s = 300 psia. Fig. 18.



HORSEPOWER as function of compression ratio, with P_s and n varying parametrically. Clearance pocket is closed, and ratio of fixed clearance to displacement volume is 1. Fig. 19.

through zero at some value of compression ratio greater than 1. This second point of zero horsepower occurs when $v_{ck}' (R^{1/n} - 1) = v_{dk}'$.

The physical significance is that no gas is being pumped. Gas is compressed and then decompressed, but no gas leaves the cylinder.

Suction pressure and gas factor are both varied as parameters, Fig. 19. Horsepower required increases as the gas factor increases for a fixed compression ratio and suction pressure. Amount of energy absorbed by raising the temperature increases as the gas factor increases.

Speed is constant for all the curves shown in Fig. 19. The curves could be considered as curves of torque vs. compression ratio with different scales. Note that any time delays introduced by the compression cycles are insignificant compared to other transient propagation times.

Rates of changes made in station horsepower are limited by time required to close a cylinder pocket, take an engine off line, or put an engine on line. These short times need no further consideration in describing limits of rates of changes for an entire pipeline system.

Control philosophy

Two broad criteria for pipeline control lead to specifics in developing the optimum system of control.

1. Control system will operate the transmission system to supply required quantity of gas to the sales points if possible. Limits exist for any transmission system beyond which operation is not possible.

2. Average power input will be minimized.

The energy losses of a gas-transmission system need consideration to find what system of control best satisfies these criteria. The losses are: friction loss within the transmission system and pressure potential loss at the sales point.

The energy lost at the sales point is not entirely lost because the customer may use it. However, from the transmission company's standpoint the energy left the system without producing revenue and therefore is lost.

Pressure required at the sales point is called "contract" pressure. Gas delivered above this pressure is excess energy supplied to the customer.

Frictional energy loss is proportional to the square of the gas velocity. Example: supply a flow, Q, through a pipeline of diameter D:

$$V = \frac{Q}{K D^2 \rho} \qquad (25)$$

K is a constant, Q and D are fixed quantities in this example. Note that as ρ increases, V decreases—and energy loss decreases as $1/\rho^2$. Density value within limits can be picked. If the largest density possible is picked then friction energy loss is minimum possible which is equivalent to operating at highest possible pressure. Upper pressure limit is determined by characteristics of the line section. Criteria of operating at highest possible pressure are applicable to both steady and transient flow.

Frictional energy loss due to transient flow is compared to energy loss in steady flow by holding constant time average of flow. Denote the time average of a function: f(t), by $\overline{f(t)}$. The two cases to compare are:

Case 1: $Q_1(t) = Q_{ss}$, a constant

Case 2: $Q_2(t) = Q_{ss} + Q'(t)$,

where $\overline{Q'(t)} = 0$

Consider the energy loss within a short section of pipe. Velocity for the two cases is then:

Case 1: $V_1(t) = V_{ss}$, a constant

Case 2: $V_2(t) = V_{ss} + \overline{V'(t)}$,

where $\overline{V'(t)} = 0$

Energy loss within the short section of pipe is proportional to the velocity squared. Therefore the average energy loss is:

Case 1: $\overline{E_1(t)} = K V_{ss}^2$

Case 2: $\overline{E_2(t)} = K [V_{ss} + \overline{V'(t)}]^2$

$= K \{V_{ss}^2 + 2 V_{ss} \overline{V'(t)} + [\overline{V'(t)}]^2\}$

$\overline{E_2(t)} = K V_{ss}^2 + K [\overline{V'(t)}]^2 = \overline{E_1(t)} + K [\overline{V'(t)}]^2$

Where K is a unit's constant.

The average energy loss for the transient flow case is greater than for steady flow since $K [\overline{V'(t)}]^2 > 0$

Operating the pipeline in a condition of steady-state is desirable, but not possible, since load varies with time. Transient effect on the pipeline system can be minimized, however, if the transient is filtered or removed as near the load as possible.

Limit the region of transient flow to that portion of the pipeline system which is near the fluctuating load so the remaining portion can operate in steady state.

Control philosophy is composed of three specific operating criteria:

1. Operate the pipeline system at the highest pressure possible.
2. Filter the transient as near the load as possible.
3. Deliver gas to sales points at contract pressure and no higher.

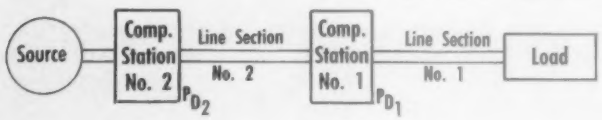
The three criteria are not independent. Satisfying all three criteria at the same time is not possible. Criterion 3 conflicts directly with Criterion 1. Criterion 3 essentially requires pressure be as low as possible while Criterion 1 requires pressures to be as high as possible.

The three criteria are each conditions which will minimize a specific type of energy loss. Therefore, optimum control system must minimize the sum of the three losses which is a complex problem.

Optimum method of control is trivial for some specific cases. Others require a knowledge of the transmission system and the loads characteristics. Frequency content of the loads specifies the load characteristics.

Two simple cases demonstrate control principles.

Consider the transmission system shown below:



Consider first the case of steady-state flow. Criterion 2—transient filtering—is not applicable since no transient is present. Where a line section delivers its entire flow to a sales point, the requirement to deliver at contract pressure will dominate over the requirement for high transmission pressure.

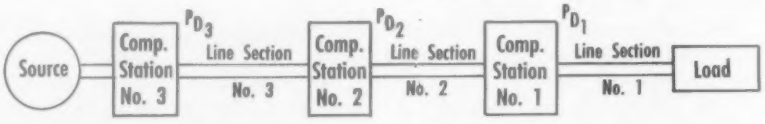
Choose P_{D1} so that gas is delivered to the load at contract pressure. Applying the requirement of high transmission pressure requires that P_{D2} is the maximum operating pressure. This defines how this specific transmission system should be operated.

Consider filtering before looking at second example. Two methods of filtering—active and passive—are available in the operation of a gas-transmission system.

The pipeline section may be used as a passive filter. The transient's amplitude decreases as a transient wave propagates from one point to another point within the pipeline section. Amount of filtering depends on line section characteristics, operating conditions, and frequency of the transient. Amount of filtering increases as frequency increases.

Compressor station may be used as an active filter. Compressor horsepower is varied to hold flow constant. Output flow fluctuations are met by changing the line pack. However, fluctuations often exceed line pack. Thus, it is not always possible to meet fluctuations and provide perfect active filtering.

Second example shows how filtering behaves. Consider the application of the control criteria to the transmission system shown below, where the flow at the load varies with time.



Consider line section No. 1. Criterion 1—highest line pressure—is not applicable since the line section delivers its entire flow directly to the load.

Operation is determined by criteria 2 and 3. These oppose each other and the optimum control method is a compromise. The basis for the compromise is the load's frequency content.

At very low frequencies the advantages of holding output pressure constant outweighs the advantages of filtering the transient such as fluctuations with a 1-week period.

Active or passive means will not filter this transient, but the line can be operated to keep load pressure constant.

At very high frequencies, the advantages of filtering outweigh the advantages of holding constant contract pressure. For example, fluctuations with a 1-hour period can be filtered by either active or passive means. Line section use as a passive filter requires the output pressure to vary.

Line section should be operated to allow no low-frequency changes to occur in the load pressure. High-frequency changes in load pressure are allowed to effect filtering. Average output pressure must be enough above contract pressure such that required pressure fluctuations never drop load pressures below contract.

Next consider Line Section 2 of second example. Here criteria 1 and 2 are applicable. Criterion 3 is not applicable since no load is present. Again filtering is useful only to the high frequencies. Holding high pressure should be applied to the low frequencies. Operate compressor station No. 2 to have the discharge pressure, P_{D2}, tend toward maximum without allowing any high-frequency changes in flow through the compressor station.

The only control criterion applicable to Line Section 3 is to hold pressure as high as possible if assumed that high frequency flow changes present no problem in the source.

If source fluctuation is a problem then compressor No. 3 can be operated the same as No. 2. Separating a high frequency and a low frequency is determined by specifying the characteristics of the transmission system and load.

Specific solution for actual lines

will require considering actual configurations and conditions. However, the solutions are merely extensions of the above results.

Methods of exercising transient control

Here is a general description of the task and locations of the equipment necessary to effect the control philosophy. Specific controllers will be treated as black boxes whose input and output functions are specified.

Control of compressors. The compressor must be a center of control because it provides the single method of introducing energy into the gas stream. Also controlled compressor operation has an important economic justification.

Compressor operation should be controlled, first, to produce the required gas stream changes, and, second, to consume minimum fuel. Both forms of compressor control are possible without interstation communications for most cases. Further, pressure set-point operation is completely adequate for all stations.

Time-dependent operation will be treated as a variable set-point condition. The inputs of the compressor set-point controller (station mode controller) are:

1. Station's present configuration—number of engines, speed of each engine, etc.
2. Suction and discharge pressures.
3. Set-point value—either suction pressure, discharge pressure, or flow.

Station mode controller's outputs are the changes required to most economically seek and maintain the control variable at its set point.

Constant load pressure control. Control of the load is a more involved problem since it must incorporate the load, line section, and compressor. A set-point controller will cause the compressor to generate control changes provided the time variable set point can be supplied.

A computation must be made to determine the variable set point required to maintain a constant output pressure for varying output flow. The required load flow prediction can be supplied only by the operating dispatcher.

An additional input should provide for the desired constant output pressure. Active input and output functions are: input—load flow predictions, output—compressor controller's set point.

Set point could be either discharge pressure or flow. However, pressure measurements are more available and accurate than flow.

Mechanizing the control philosophy. Control philosophy dictates maintaining a constant delivery pressure for the load-terminated sections. This criterion can be followed by using a combination of the two general controllers coupled by a narrow-band communication link. Criterion 2 requires elimination of any transient as near the load as possible. This is done by coordinating the operation of two consecutive compressors. The compressor nearest the load should operate on a suction pressure set point.

Discharge pressure of the upline station is kept at a constant set point. No transients will propagate into this block regardless of the downstream transients. The limit is that the discharge pressure of the loadside compressor is greater than its suction.

Criterion 3 can be affected by making discharge set points as high as possible while not violating other criteria or exceeding the maximum line pressure.

Frequency selective method of control can be done by these locally sensed controllers with the addition of simple frequency filters.

Cost effect

Any control system will be useful only to the extent that it saves operating costs.

Frictional losses are considered with respect to possible savings resulting from maintaining high pressure.

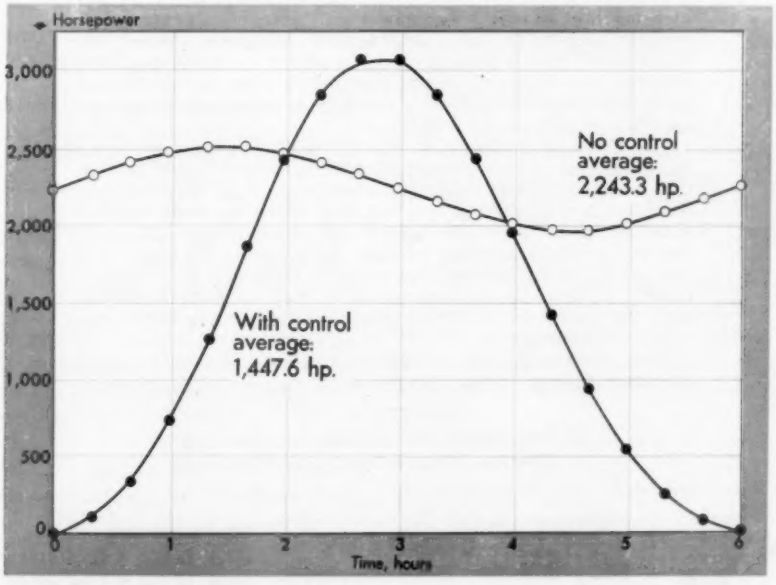
Table 2 shows horsepower lost in the line section for various input pressures. Horsepower losses were obtained directly from the frictional energy loss expression.

Table 2

Output pressure	Input pressure	Horsepower loss	Approx. yearly fuel cost
150	390	7,546	$196,196
309	470	3,052	$79,352
437	560	1,735	$45,110
582	677	1,019	$26,494
761	833	585	$15,210

Fuel cost in a specific case depends on line location with respect to source. Here a cost of 30 cents per M.c.f. was used. Yearly net saving is $11,284, resulting from operating at 833-psia. input rather than 677 psia.

Line used was 20-in. in diameter and 30 miles long with a 172-M.M.c.f.d. flow. Higher losses occur for longer line sections.



HORSEPOWER for given flow as function of time, for cases of no control, and perfect control. **Fig. 20.**

Also, the control system may lower initial investment. If it is possible to exercise close control, then the amount of equipment to assure delivery may be reduced. The consequent savings in capital investment may be realized through application of the transient solution to pipeline design. A thorough treatment is outside the scope of this report.

Controlling discharge pressure. Let's examine two cases to determine possible savings accruing from the use of "perfect control."

The first assumes no control—load was satisfied from line pack with excessive pressure throttled at the load. Input pressure was held constant and output pressure varied such that minimum output pressure was 150 psia.

The second assumes perfect control—output pressure was held constant at 150 psia. Output flow for both was varied sinusoidally with a period of 6 hours. A plot of required input horsepower as functions of time shows the difference between the two cases, Fig. 20.

No control case yields an almost constant curve. Controlled case requires a time-variable horsepower. Peak horsepower to accomplish control is higher than the no-control case.

However, average horsepower is smaller for the controlled case. An analytical expression was derived for studying decompression losses for any line.

Conclusions

Information presented here can be used for studying any gas pipeline. Applying the theories and criteria to existing lines has proved the validity and usefulness of the study. However, each specific line will always require individual analysis.

Several lines were examined for possible payout with assumed control equipment based on report's criteria. Resulting payout periods were much shorter than usual.

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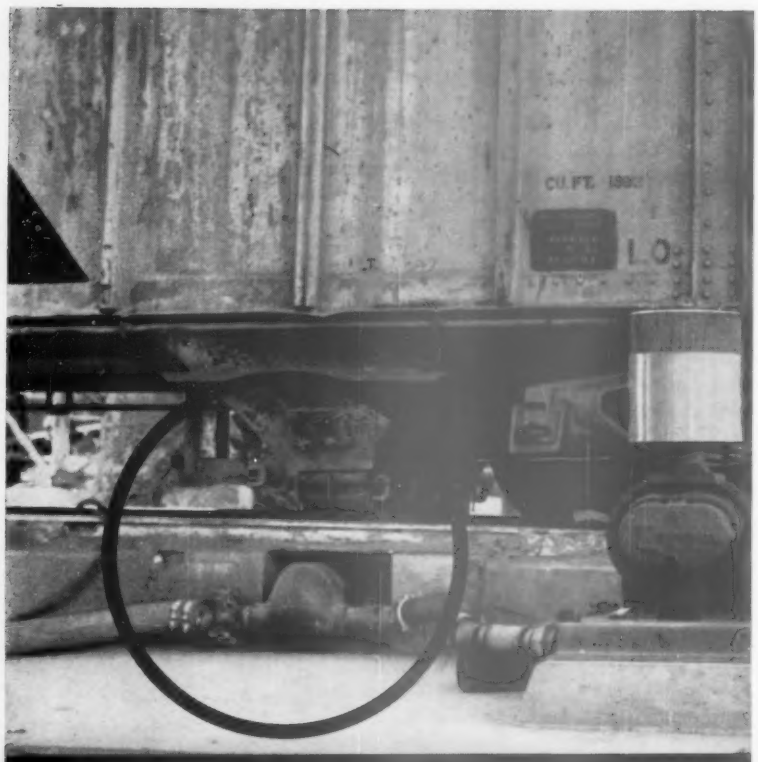

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PROCESSING NOTES

Thermosiphon-reboiler design and cooling-water corrosion discussed at AIChE meet

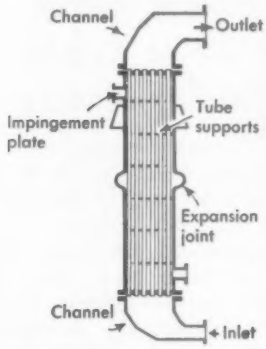
THERMOSIPHON reboilers represent one of the more difficult design problems in the heat exchanger field. Thermal design is complicated, and many mechanical design features are selected only after completing thermal design.

Cooling-water corrosion, particularly when circulating brackish water, presents design problems in material selection and mechanical design.

Two speakers discussed these subjects in separate papers presented at the sixteenth annual technical meeting of the South Texas section of AIChE in Galveston, recently.

Thermosiphon Reboilers

C. H. Gilmour, Union Carbide Chemicals Co., told the meeting some of his philosophy for designing certain parts including: outlet and inlet connections and channels,



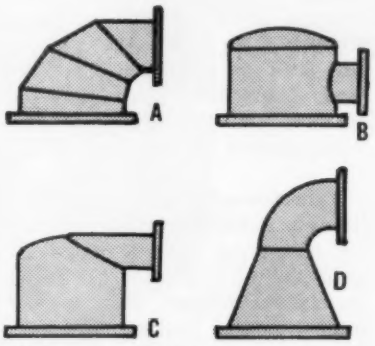
VERTICAL thermosiphon reboiler should be designed with minimum outlet-nozzle pressure drop. Fig. 1.

impingement plates, tube supports, and expansion joints.

General arrangement of a vertical thermosiphon reboiler is shown, Fig. 1. Liquid-to-vapor ratio leaving the outlet nozzle varies with a number of factors such as: liquid level, entering fluid composition, tube size, and pipe sizes and lengths.

Outlet nozzle should have a minimum pressure drop for optimum performance. Nozzle velocity should almost equal the velocity leaving the tubes. Thus, the composition of the material leaving the tubes makes no difference. Nozzle diameter is equal to the square root of the number of tubes times the tube's internal diameter. If the calculation does not result in a nominal pipe size choose the next-smaller size. Inlet size, generally, is half the diameter of the outlet because of lower pressure drop in this piping. Select a standard pipe size, however.

Outlet channel design. This is based on the concept of maintaining pressure drop in the outlet nozzle. Reducer-type channel, Fig. 2a,



OUTLET CHANNELS for vertical thermosiphon reboilers. Fig. 2.

is the most expensive, but should give the best performance because flow path of material leaving each tube is nearly uniform.

Conventional channel, Fig. 2b, should have a high pressure drop because flow conditions from tubes will be variable. Performance is between 30% and 40% less than with the reducer channel. Variations of the conventional channel, Figs. 2c and 2d, still have more disturbances than the reducer type.

Inlet channel of the reducer type should minimize disturbances and approach more even distribution to each tube.

Impingement plates. These should be provided because of the wide range of steam pressure, superheat, and quantity experienced in thermosiphon reboiler operation. However, Gilmour says, impingement plates are not necessary for liquid velocities less than 8 ft. per second or clean gas.

Tube supports prevent loosening of tubes in the rolls during shipping. Also, they increase velocities, film coefficient, and net over-all steam side coefficient. They tend to strip off condensate and leave more unwetted area throughout the bundle.

Expansion joint experience indicates no chronic problems with a number of different designs. Union Carbide's custom is to use double flanged and flued rings.

Cooling-water Corrosion

Heat exchangers generally are designed to resist process-side corrosion, said W. G. Ashbaugh, Union Carbide Chemicals Co. However, sometimes the cooling water is more important, especially when brackish waters are the cooling media. Union Carbide's Texas City plant cools with Brazos River water which has a high mineral and total-solids content.

Here are some do's and do not's Union Carbide has learned about reducing corrosion in brackish-water service:

1. Vent the top of the shell side of vertical exchangers. Minerals concentrate in the vapor zone at the top of the tubes when cooling water is on the shell side. Exchanger-tube life with vents is about double that without vents.

2. Use similar metals whenever possible and thus reduce the possibility of creating a sacrificial anode.

3. Use high water velocities, 3 to 8 ft. per second, except with copper.

4. Install nozzles as close as possible to the tube sheets when cooling water is on the shell side.

5. Put cooling water on the tube side whenever possible.

6. Chemically clean often and prevent the buildup of corrosion products and deposits.

Asphalt specs draw fire

The industry must develop good tests which will predict road durability, say conference speakers

ANOTHER ROUND in the battle for more realistic asphalt specifications was fought last month at University of Idaho's annual asphalt conference at Moscow, Idaho.

While most asphalts meet any of the current widely used specifications, it is also true that many good asphalts fail to meet them. The trouble with present specifications is that they do not provide information which is directly related to road durability.

P. J. Ruckel, of Continental Oil Co.'s Denver refinery, outlined some of the problems with current tests and pointed out where research efforts are being made.

For instance, the industry badly needs some good tests which will measure the colloidal properties of asphalt.

Most asphalts are neither true fluids or solids, but are viscoelastic materials. Gelatin is an example. When warm it is a fluid. Cooled, it stiffens to a gel, but will revert to a sol if heated. All asphalts have a certain amount of gel structure. It appears to increase as the pavement ages; therefore, many people believe that it contributes to undesirable pavement brittleness.

Ductility tests now in use separate gel-type asphalts from those which have little gel structure. Some people believe that ductility measures the resiliency of asphalt, or its ability to "heal" after fine cracks develop. Others believe that they measure only "stickiness, tackiness, or adhesiveness." The dispute rages because documented field evidence has never been developed to support either of these theories.

Chemical changes. Other tests are needed which can accurately predict chemical changes.

Asphalt composition is continually changing. A large part of the total change comes during construction when high-temperature films are exposed to air. Slower modifications continue after the road is in service. Ultimately, the performance properties of the road are altered.

Efforts have therefore been made to predict such changes by laboratory tests. Oxidation is considered the most important chemical change. But few of the analytical methods proposed to measure this property have been simple enough or supported by sufficient field performance to be of practical value.

Reduction of slow-curve oils to 100-penetration asphalt measures heating at 500° F. This empirical test gives a rough idea of the residue obtained at specified conditions.

The trouble is that the test doesn't necessarily indicate what happens in the road. Slow-curing products often require more than a year to reach that hardness in a road; some never get there; and others may cure to a harder residue within months.

Thin-film-oven test shows promise as a method to predict hardening of asphalt cements. Data are available which show reasonable correlation between thin-film-oven results and the change in penetration during hot mix operations.

Whether these data, which are obtained at 325° F., can be correlated with the hardening rates of pavement at its much lower service temperature remains in question. Yet another problem is that many asphalts do not meet the thin-film-oven specification, although there is no evidence that the pavement quality obtained from these asphalts is inferior.

Other specifications related to asphalt workability also came under critical fire, but Ruckel noted several encouraging trends.

One was that Kansas and Idaho had adopted the kinematic viscosity test at a single temperature. This proves, he said, that there is a healthy atmosphere which assures a fair hearing for any improvement that can be supported with reasonable field data.

Big butane splitter goes up at Amoco's Texas City refinery

NEW processing units are beginning to take final shape at the modernization program at American Oil Co.'s Texas City refinery.

Recently completed are a 14,000-bbl. alkylation plant, the world's biggest; butane-splitting facilities; and a 12,000-bbl. isomerization unit. Fluor Corp. built the units for American.

One of the highlights of recent construction was raising a 201-ft. butane splitting tower. Fluor used its two largest gin poles to raise the tower, which is one of the biggest ever raised in one section. It took six heavy-duty flatcars to move the 300-ton vessel from a Beaumont plant to the refinery.

The new units are part of a big expansion and modernization at Texas City. Among the other new units nearing completion are a 150,000-bbl. pipe line and a 47,600-bbl. catalytic cracking unit.

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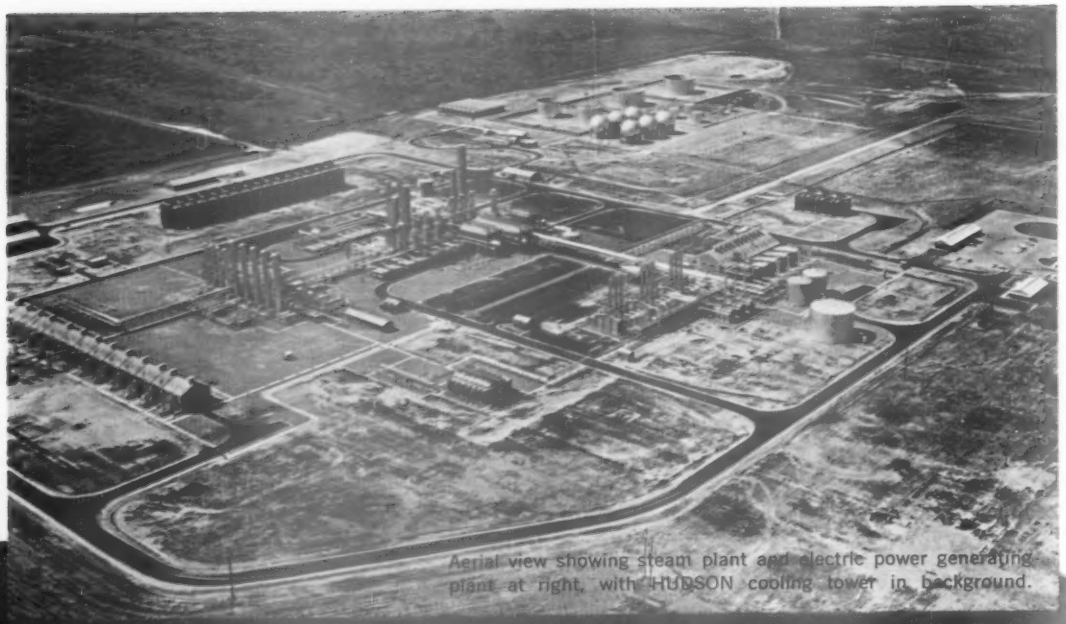

Aerial view showing steam plant and electric power generating plant at right, with HUDSON cooling tower in background.

The twin KING RANCH plant has operated continuously since initial start up 17 months after the date of contract.

Experience

30 years of experience in process plant engineering and construction of projects throughout the free world qualified Hudson as turn-key contractor for the plant here pictured — one of the world's largest gas processing plants. Constructed on the King Ranch of southwest Texas, this plant, owned by Humble Oil and Refining Company, has operated continuously since initial start-up.

Whether your future project is large or small, in the United States or abroad, in whatever clime or terrains, Hudson is qualified by experience to serve you with speed, ability and integrity.

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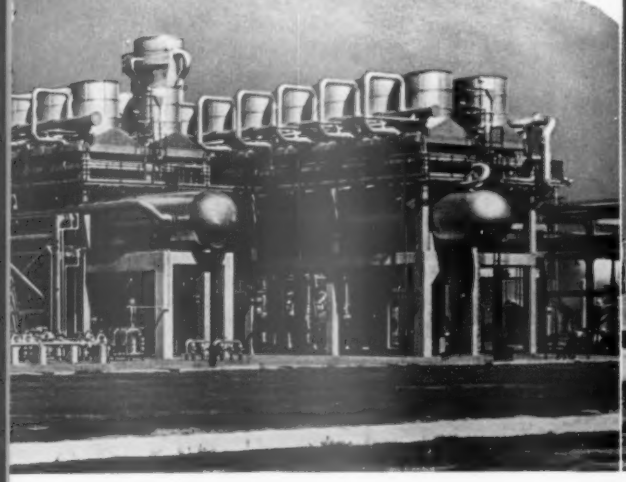
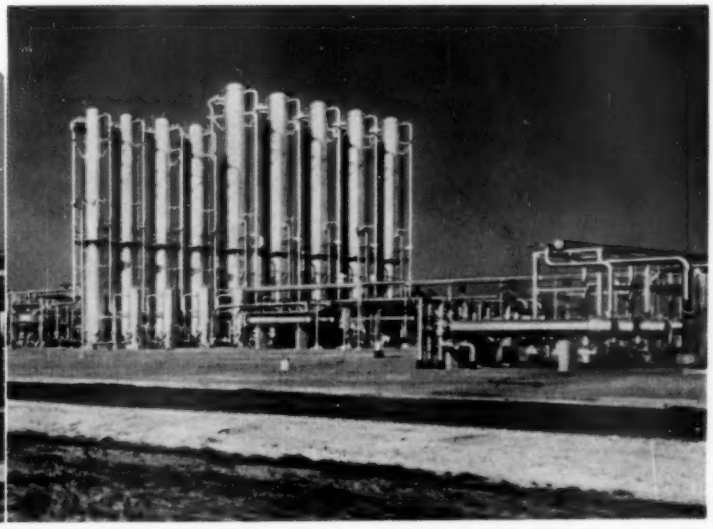
PROCESS AREA: Two storied concrete structure accommodates HUDSON SOLO-AIRE condensers on top level. HUDSON COMBIN-AIRE, a combination of Solo-aires with water cooling tower, is used for other cooling services.



HIGH PRESSURE ABSORPTION AND GAS DEHYDRATION AREA



Dowell Acidizing

-- lowest cost way to stimulate many oil and gas wells.

Pioneer in the field of acidizing, Dowell has constantly improved both the engineering of acid treatments, as well as the products and services themselves. Here are some of the important field proved acidizing services offered by Dowell to help you get the best possible results.

RETARDED ACIDS — slow-acting acids designed to penetrate deeply before spending. They are used to improve production from fast-reacting, vugular, oolitic, or naturally fractured formations.

MUD ACID — a special acid solution that dissolves and disperses mud on screens, liners, perforations and the pay. It also increases permeability of certain sand formations which have low solubility in regular acid.

BDA* BREAKDOWN ACID is designed to penetrate and disperse mud cakes by reducing surface tension, by preventing and breaking emulsions and by removing water blocks. It is often used to break down formations ahead of fracturing, cementing and conventional acidizing treatments.

SILICATE CONTROL ACID has special agents added to prevent the swelling of clay minerals and other formation silicates. It also prevents or breaks certain emulsions.

STABILIZED ACID contains an additive to prevent the formation of formation-plugging iron hydroxide precipitate. Many troublesome water injection wells have been successfully treated with Stabilized Acid.

ADDITION AGENTS are available to reduce surface tension, prevent or break emulsions, remove or prevent the formation of compounds that might plug the formation, and speed up or slow down acid reaction with the formation.

Acids may be tailored to the requirements of a specific well by the use of one or more Dowell addition agents.

MANY AUXILIARY DOWELL SERVICES are available to help make acidizing treatments more effective. These services include Abrasijet* abrasive jetting service and a number of diverting agents for selective or multiple zone acidizing.

SEVERAL FRACTURING SERVICES that employ acid-base fracturing fluids are offered by Dowell. Often, wells fractured with acid-base fluids give higher production or flatter decline curves than could be expected from either acidizing or fracturing alone.

THE ACID GUIDE* — Dowell's method for planning and predicting the results of acidizing treatments — helps operators get the most profitable treatments for their wells.

For greatest profits, check on Dowell field-proved acidizing for every well you plan to treat. Ask your Dowell representative for full information. Dowell services and products are offered in North and South America, Europe, North Africa and Iran. Dowell, Tulsa 14, Oklahoma. *DOWELL SERVICE MARK

SERVICES FOR THE OIL & GAS INDUSTRY

DOWELL

DIVISION OF THE DOW CHEMICAL COMPANY

To safeguard against them, bone up on their behavior. Here's

What you ought to know about REFINERY FIRES

The traditional method of designing refinery fireproofing, by blanket specification of a 2 or 3-hour ASTM fire-resistance rating, is easy on the engineer but can be hard on structures and profits. Fires can be much hotter than the standards recognize. You should look closely at fire hazards, area by area, and adjust the fire protection to fit the specific situation.

BY J. F. WYGANT
Research and Development Department
American Oil Co., Whiting, Ind.

TO DESIGN fireproofing effectively you must know what kind of fire to expect. Recent serious fires show that merely relying on ASTM fire-resistance ratings is no longer adequate.

Three unusual characteristics of refinery fires require particular consideration: speed of development, available fuel, and the temperature reached.

Speed of Development

Most of the contents of refinery vessels and piping are at least partly volatile at moderate temperature. Many are already heated above their initial boiling points, or even their spontaneous-ignition temperature. With such fuels, a fire often develops near-maximum temperatures almost immediately.

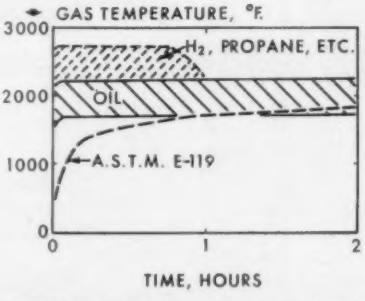
By contrast, a gradual rise of temperature is typical of fires in buildings. Some representative time-temperature curves are shown in Fig. 1. The slower development of building fires is the basis for the ASTM E-119 standard fire test curve used almost universally to determine fire-resistance ratings.

The first half hour of a moderately hot (1,800° F.) oil fire is almost 50% more severe than the first half hour of the standard test, in terms of the time-temperature integral (the area under the curve). In terms of heat radiated to fireproofed surfaces, the difference may be even larger, and most of the heat transfer in a fire is by radiation.

Building fires usually feed upon limited supplies of fuel—typically the building itself and its contents. The amount of heat that can be released—(roughly the area under the time-temperature curve)—depends upon the amount of fuel available per unit volume of space involved in the fire. This amount is roughly equivalent to the loading of combustibles per unit of floor or ground area.

Some average loadings,[1 3] and the ASTM standard fire exposures which would cause the same damage (the ASTM fire severity),[2 3] are shown in Table 1. Potential severities can vary widely; one warehouse or storeroom may contain far more fuel than another.

Refineries and petrochemical plants not only contain large weights of fuel, but that fuel has heating values averaging about twice those of wood, cloth, or paper. Also, most combustible industrial materials are solid and stay in one place, but in a refinery fire pressurized pipes and vessels in the fire area may fail and add more fuel to the fire.



REFINERY FIRES develop much faster than those on which the ASTM fire-resistance standard is based. Fig. 1.

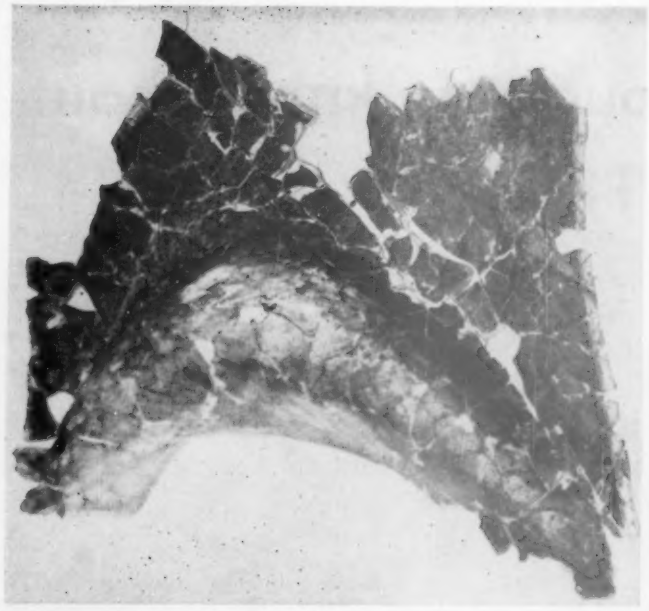
A warehouse heavily loaded with 180 lb. per sq. ft. of ordinary 7,500-B.t.u. per lb. combustibles could generate about 1,350 B.t.u. per sq. ft., and often would require several days to burn completely.

But an oil tank 100 ft. in diameter by 40 ft. tall, 90% full, if ruptured and spilled into a dike enclosure 400 ft. square, frees about 2,000,000 B.t.u. per sq. ft. of the enclosure. This fuel would burn out in 2 or 3 hours, if it were gasoline, with a rate of heat release perhaps 10 or 20 times that of the warehouse fire.

A horizontal liquid propane drum 10 ft. in diameter contains about 6,500,000 B.t.u. per sq. ft. of ground space occupied, and propane burns several times as fast as gasoline. A single naphtha reformer reactor, 8 ft. in diameter by 20 ft. tall and filled with 80% hydrogen and 20% naphtha vapors at 250 psig., contains about 18,000,000 B.t.u.; it can be released in an area of a few square feet within a few minutes, if a transfer line ruptures.

Temperatures Reached

The rapid development of refinery and petrochemical fires can involve large amounts of fuel of high heating value, and can quickly release large amounts of heat. The temperatures reached may therefore be very high. They depend upon the kind and amount of fuel in-



WIRED WINDOW GLASS was in a distillate-fueled fire. Laboratory duplication of these results showed that the glass had been at about 1,300° F. Fig. 2.

CRACKED HOLLOW TILE and buckled tank plates show that this distillate fire reached 1,600°-1,900° F. Fig. 3.

volved and the circumstances of the burning.

Distillate fires. When the fuel is a liquid distillate, and either fuel or air is in limited supply, maximum temperatures are not likely to exceed 2,000° F., they may be as low as 1,200° to 1,400° F. The lowest temperatures probably are those in ground fires when the fuel barely covers the ground or floor. Temperatures of 1,400° to 1,600° F. are likely when air is not freely mixed with the fuel vapors. Such is the case when the fire is confined in a tank or a closed building, or is at ground level among closely spaced structures so that a strong draft can not develop. Fires in oil-soaked insulation likewise do not usually reach very high temperatures.

If distillate fuel is freely available and the fire is not closely confined, thermal drafts develop. In parts of the fire accessible to enough air, temperatures above 1,800° F. can be attained.

For example, kerosine and fuel-oil fires have been confined in metal enclosures up to 24 in. in diameter and in brick checkerwork enclosures 4 by 6 ft. Thermocouples traversing the flames indicated temperatures of 1,350° to 1,650° F. when no effort was made to provide large amounts of air. When kerosine was fed as fast as it would burn into a gravel-filled pan in the base of the brick enclosure, and a copious supply of air was provided at the base of the fire, flame temperatures ranged from 1,600° to 2,050° F.

Evidence from refinery fires points to similar temperatures for this kind of fire. Fig. 2 shows wired window glass from a pipe-still receiver house after a fire fed mostly by heavy and middle distillates. Laboratory duplication showed that the glass had been at about 1,300° F. Higher temperatures would have caused more softening and flow, and possibly crystallization.

Many tanks have been observed after fires in which the fuel ranged from naphthas through heavier distillates. The results correspond to those in Fig. 3. Failure of the hollow tile by cracking of the webs and moderate-to-severe deformation of the tank sides indicate temperatures probably above 1,600° F., but lack of devitrification or melting of the mineral wool and the absence of warpage or bending of the tile indicates a temperature not exceeding 1,900° F.

Asphalt fires. Asphalt can be a highly destructive fuel, even though it is far less easily ignited than liquid hydrocarbons. Fig. 4 shows one side of the brick sheathing around a tank exposed to an asphalt fire. The melting and slight flow of the brick was duplicated at 2,100° to 2,200° F. Hollow tile at the base of another tank exposed to the same fire melted and flowed at 2,300° F. or higher, often breaking in half through the webs at lower temperature.

Temperatures well above 2,000° F. can be reached in an open fire involving plentiful supplies of light-distillate liquids, if it becomes large

TABLE 1—Typical combustible loadings and fire severities

Type of occupancy—	Typical combustible loading, lb./sq. ft.*	Equivalent ASTM fire severity, hr.†
Home, office	less than 10	½ to 1
Common storage	10 to 15	1 to 2
Store, factory	10 to 50	1 to 4
Warehouse	10 to 180	up to 5
Oil refinery‡	up to 750	up to 8 or more

*Weights of combustibles adjusted to heating value of 8,000 B.t.u./lb. †Hours in ASTM E-119 fire test required to do equal damage. ‡Estimated.

ASPHALT FIRE melted this brick surface, showing the temperature reached 2,100°-2,200° F. Fig. 4.

CONCRETE FIREPROOFING and structural steel were melted down into slag from a light-hydrocarbon fire which reached 2,600° F. or higher. Fig. 5.

enough to develop a strong draft. In one fire, in a closely spaced tank field containing gasoline, naphthas, and other products, valves of gray cast iron were melted while adjacent cast-steel valves were not. This contrast placed the temperature between 2,100° and 2,700° F.

Light-hydrocarbon fires. The highest temperatures, 2,500° to 2,700° F., are reached in fires fueled by hydrogen, mixtures of hydrogen and naphtha vapors, and such light hydrocarbons as propane. These materials almost always are supplied to the fire under pressure through leaks or broken piping. Released as gases, they mix turbulently with air, and apparently often create a "blow torch."

After a fire at the site of a puncture in the depropanizer tower of an alkylation unit, concrete fire-proofing and the structural steel it protected were melted down into a slag, as shown in Fig. 5. Phase diagrams[4] showed that temperatures of at least 2,400° to 2,600° F. were required to melt iron oxide and concrete.

Fireproofing concrete was spalled extensively as far as 30 ft. from the tower, and concrete aggregate particles were melted, at 1,800° F., or above, 20 to 25 ft. away. The concrete surface was melted at 2,300° to 2,400° F. at a distance of 20 ft., as shown in Fig. 6.

In another fire, caused by rupture of a reformer-reactor transfer line, the "blow torch" of burning high-hydrogen vapors impinged directly downward on the concrete slab. The rate of heating was so rapid that the slab spalled repeatedly in thin layers, until the subgrade soil was exposed.

This behavior is typical of rocket-launching pads, exposed to high-velocity exhaust gases at 4,000° F., or above.

The theoretical flame temperature of naphtha and hydrogen burned with air is 3,800° to 4,000° F., but these temperatures probably were not reached because of imperfect mixing. Nevertheless, concrete fireproofing 20 to 30 ft. from the reformer fire had suffered repeated surface melting and spalling, denoting temperatures above 2,300° F. Structures over 50 ft. away suffered damage. Temperatures near the center of the fire must have been above 2,500° F. and probably were at least 2,700° F. The extensive spalling showed that these temperatures were reached immediately, as would be expected under the conditions.

SURFACE OF CONCRETE fireproofing was melted at a distance of 20 ft. from propane fire. Fig. 6.

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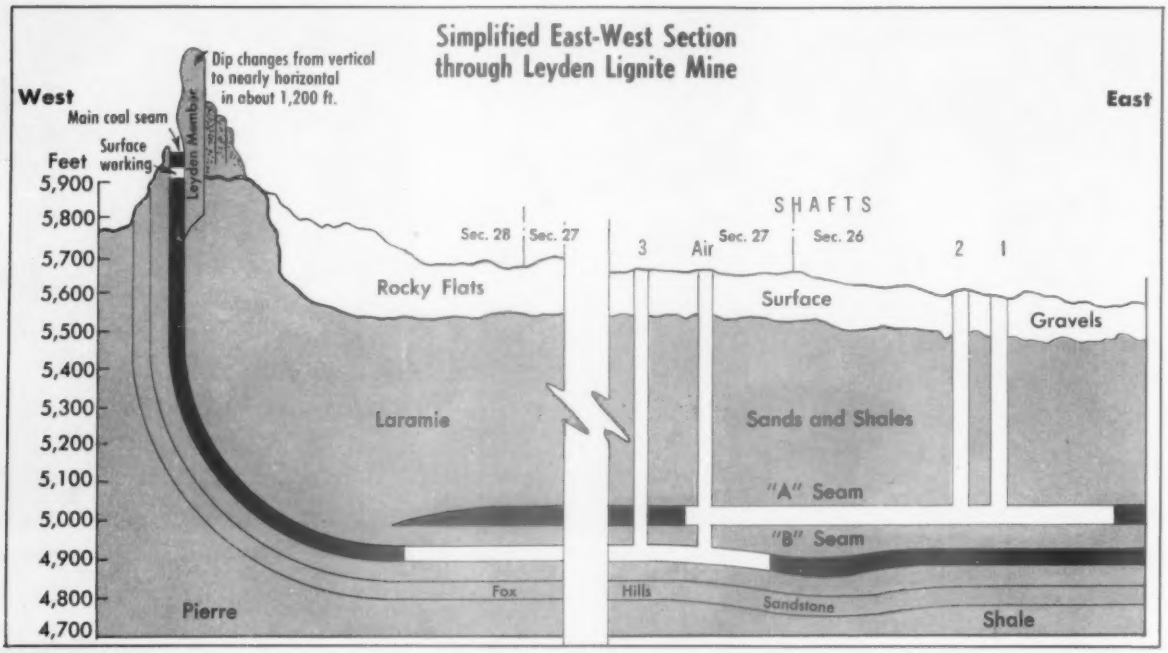
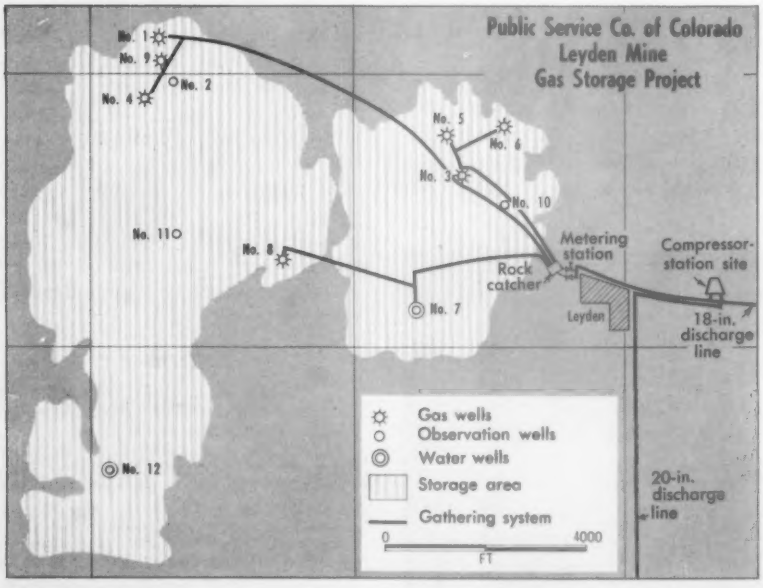


CROSS-SECTION through the Leyden lignite mine shows the sharp change in dip to the west of the mined-out zone. Permissible storage pressure is believed fixed by the hydrostatic head equivalent of the vertical distance between the coal seams and the outcrop at the Rocky Mountain foothills.

Old coal mine converted to gas storage

A first in the industry, the completed project will store 3 billion cubic feet of gas for peak shaving. Here's how job was done.



MINED-OUT CAVERN of the Leyden gas-storage project dips to the south. Injection and production wells are located in the upstructure portion to the north, and wells for mine dewatering are in the lower south part of the workings. Well No. 8, now a gas well, was used for dewatering before well No. 12 was drilled.

BY W. B. BLEAKLEY
Production Editor

PEAKS AND VALLEYS in the load curve were too far apart, and Public Service Co. of Colorado decided a gas-storage reservoir was needed in the Denver area.

This was the beginning of what is now a successful project, and one that will increase the load factor to about 70%.

The consulting firm of Ball & Associates, Denver, studied 16 structures reasonably close to Denver, and reported on storage possibilities. All but three were rejected immediately, and the Leyden mine was finally chosen for these reasons:

- Close to Denver, the major load center.
- Cavern would provide higher injection and withdrawal rates than a porous medium.

Mine description. The Leyden

mine is 14 miles northwest of Denver. From 1903 to 1950 it was operated continuously, with coal being extracted from the lower 150 ft. of the Upper Cretaceous Laramie formation.

There are two main seams in the mine, the "A" and the "B." The A seam is in the east portion of the mine, and the B seam, the newer workings, is in the west portion. The B seam is generally 50 ft. lower than the A. Depth to the coal varies from 700 to 1,000 ft. below the surface, and thickness varies from 8 to 20 ft.

Coal was mined by what is known as the "pillar and chamber" method. Vertical shafts were drilled into the workings, two for each seam. Horizontal tunnels were dug from the bottom of these shafts. These tunnels were dug in pairs, parallel to each other and following the natural dip of the coal seam.

When the tunnels reached a predetermined distance from the vertical shafts, a crossconnecting tunnel was dug. This established air circulation in the workings. Air was taken in through one of the vertical shafts, along a tunnel, through the connecting tunnel and out the other parallel tunnel to the second vertical shaft.

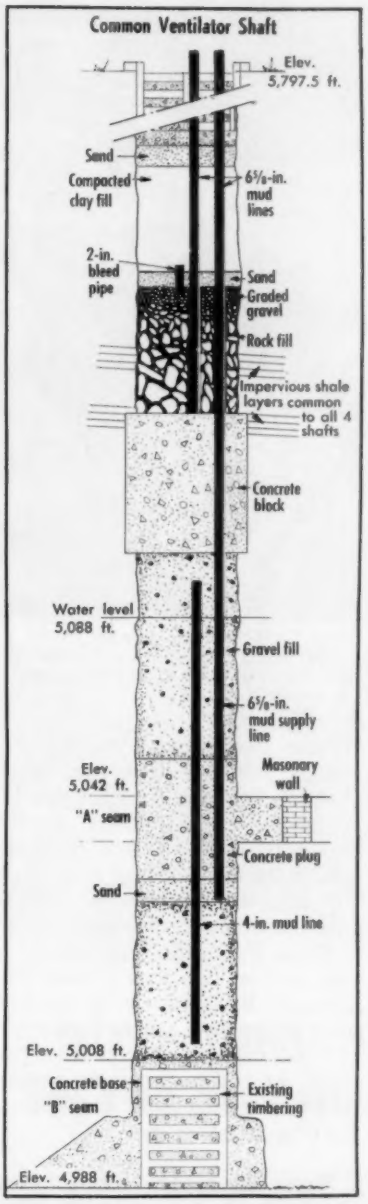
With circulation established, the parallel tunnels were extended, and another connecting tunnel was dug. At this point the previous connecting tunnel was barricaded, and circulation was established to the ends of the parallel tunnels.

When the two main tunnels approached the economic end of the coal seam, additional tunnels were dug at right angles to the tunnels. These were dug in pairs also, and air circulation was established by crossconnecting as before. Barricades in the main tunnels at strategic locations channeled the air as needed.

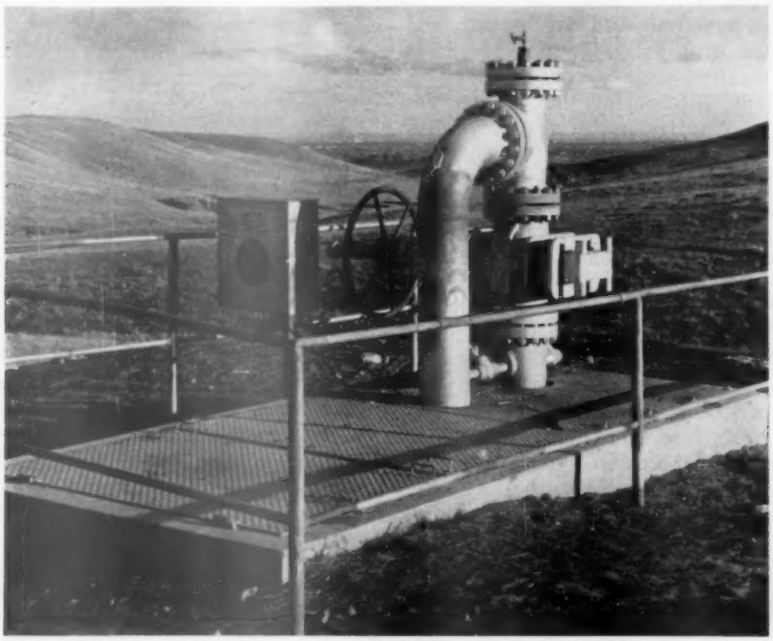
With air circulation again established, the walls of these new tunnels were mined away, with just enough material left at intervals to prevent the roof from caving. The result of this method was a large number of chambers, with the roof of each chamber supported by coal pillars at frequent intervals. Hence the name pillar and chamber for this mining method.

In the Leyden mine, vertical shafts Nos. 1 and 2 penetrated the east workings, and Nos. 3 and 4 shafts were used to provide air to the west workings. The only connection between the two levels, A and B, is in No. 4 shaft which serves as a common ventilator shaft for the two seams.

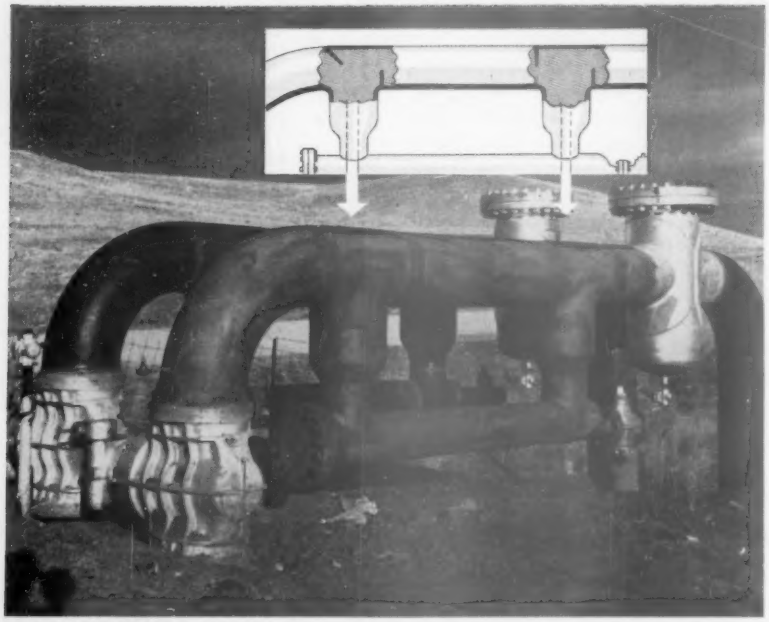
The coal seams and adjacent strata are fairly horizontal, but fold vertically upward and outcrop about a mile west of the mine. The vertical distance between the surface outcrop and the mine's operating level fixes the pressure at which the reservoir is to be operated. This



SEALING OF SHAFTS was one of the most important operations in the preparation of the mine for gas storage. Method shown here, for shaft No. 4, is typical of the plugging operations in the other shafts. Difference is that this shaft is the only one common to both the A and B seams, and an extra concrete plug was needed.



LARGE-DIAMETER FLOW LINES are used at the Leyden project. Reservoir is at fairly low pressure, and wells are produced through 7-in. casing.



ROCK CATCHERS are located in the two main lines of the gathering system upstream of the metering and compression stations (see map). Diagram, (inset) shows how the rock catchers were designed to trap mine debris and protect metering equipment.

distance is about 700 to 1,000 ft., and engineers have placed an upper limit of 300 psi. on the storage project, at least temporarily. Future tests may show that the reservoir will be able to withstand more than 300 psi., but this will not be attempted without considerable study.

While the mine was active, a total of 6 million tons of coal was removed. By applying an average specific gravity, a void space of 150 million cubic feet was calculated. At 300 psig. operating pressure, the mine should hold about 3 million M.c.f. of gas.

Water filled. The configuration of tunnels, shafts, etc. in the mine was determined approximately by referring to old mine records, and by interviewing former mine employes. The mine had filled up with water after abandonment, and it was impossible to make an inspection of the workings. With the sketchy details available, work was started.

Incoming water had sealed the mine entrances through the shafts, and it was reasoned that a well drilled into a cavern at the structural high could be used to test the mine for soundness, at least up to the pressure of the hydrostatic head in the vertical shafts.

Accurate locations of the coal pillars left in the mine were not known, and drilling into the mine in the hope of penetrating the cavern was a hazardous undertaking. The first test well drilled, 1 Leyden, actually hit an unmined area, in the west workings, rather than the cavern, as expected. Cores were taken during the drilling of this well, however, and they showed that the strata above the coal seam were of sufficient competency and of low enough permeability to serve as a "cap rock" for the reservoir.

A second well was staked, and was drilled with the same results as the first—into a coal pillar. This was discouraging, but it was decided to try fracturing the wells in an attempt to break through the small coal pillar rather than drill any more wells at that time.

Fracturing was successful in 1 Leyden, and after 3 days the wellhead pressure had built up to 8 psig., indicating that an air bubble was trapped in the mine, under hydrostatic pressure. Fracturing in 2 Leyden was not considered successful. Some communication was established, and the well is being used for pressure observations, although there is too much of a barrier left to permit injection of gas through this well.

Air, gas injected. Portable compressors were set up to inject 10,000 M.c.f. of air into the virgin air space in 1 Leyden to further test the mine for storage possibilities. Pressure in the mine built up to 11 psig. and held constant for about 2 weeks. While this pressure was far below the anticipated operating pressure, it served as an indication that the mine was well sealed, at least down to the water level.

A third well was drilled in the east workings, and penetrated the cavern with no difficulty. A connection was made to existing transmission facilities, and injection of natural gas into 3 Leyden was started immediately, at a rate in excess of 1,000 M.c.f. per hour. At the end of 1 week it was estimated that 50,000 M.c.f. of gas had been injected, and wellhead pressure was up to 93 psig. Shortly thereafter the gas in the mine blew the water seal in the No. 4 shaft, and it was necessary to flare about 25,000 M.c.f. of gas to relieve the pressure and reestablish the water seal.

West side tested. Having established the fact that the east workings were suitable for storage, a well, 4 Leyden, was successfully drilled into the cavern in the updip part of the west workings.

After installation of the necessary piping, gas was injected simultaneously into the east and west workings. As of the end of 1959, gas in storage amounted to 165,000 M.c.f. at an average pressure of 50 psig. During the next year pressure was increased to 200 psig. and gas in storage amounted to 750,000 M.c.f.

But gas in storage is of no value unless it can be delivered to the consumer. To test the deliverability of the reservoir, a 1,725-hp. compressor station was built. During the 1959-60 heating season several trial runs were made, with small amounts of gas being delivered into the distribution system.

Caverns sealed. Trial runs with small withdrawals pointed out some operational difficulties that had not been anticipated, but these minor troubles were easily overcome. Next step was to seal the ventilating shafts so that storage at full pressure could begin.

Shafts 3 and 4, the last ones used for mining, were in fairly good condition, and little preliminary

Inserting 3-inch pipe made of MARLEX (lengths previously joined by butt-fusion) through old 6-inch steel pipe. Insert photos show new 2-inch main with joined 1-inch service (also MARLEX) . . . and butt-fusion rig with completed joint.

Union Gas System, Inc., installs pipe made of MARLEX*. . . joining costs 83% less than steel

Union Gas System, Incorporated, Independence, Kansas, has recently replaced some 10,000 feet of leaking and corroded steel gas lines with pipe made of MARLEX high density plastic. The job was done with much of the MARLEX pipe inserted through existing steel lines—in Skiatook, Oklahoma, and Caney and Coffeyville, Kansas.

Mr. Forrest Martin, District Superintendent, says, "these installations with MARLEX pipe have really been an eye opener for our company. In pulling through old lines, we installed 1500 feet in four hours at Caney . . . and 3040 feet in even less time at Coffeyville." He adds, "In a time study, we found that two men with a butt-fusion rig joined 800 feet of MARLEX pipe and installed several service "T's" in four hours. The same job with steel pipe and welded joints would have taken four men at least 12 hours . . . *conservatively an 83% reduction in joining costs with MARLEX pipe and fittings using the companion butt-fusion process.*"

Mr. Martin concludes, "MARLEX pipe and butt-fusion should really revolutionize gas distribution! There is the expectation of an almost indefinite, corrosion-free service life . . . and the pipe itself is inexpensive, lightweight, easy to handle and install."

In addition to being lightweight, coilable and straight lengths of pipe made from MARLEX TR-212 (ASTM Type III polyethylene) possess excellent load bearing characteristics and a wide usable temperature range. This pipe is also virtually indestructible . . . resistant to solvents, acids, alkalies, oils, bacteria, rot and fungi.

*MARLEX is a trademark for Phillips family of olefin polymers.

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PHILLIPS 66 MARLEX PLASTICS

work was needed before sealing operations began. Shafts 1 and 2 were filled with mine tailings and debris, since they had been abandoned several years earlier. This meant that these shafts had to be cleaned out prior to sealing operations.

In an effort to learn more about the conditions at the bottom of shafts Nos. 3 and 4, an underwater television camera was lowered into these shafts.

Using the method developed by the consulting firm of Fenix & Scisson, a concrete plug was poured in the bottom of each shaft to a point 20 ft. above the shaft bottom. Common bank-run gravel was then placed on top of the plug up to the elevation of the final water level. The main concrete plug was poured on top of the gravel, and was about 18 ft. total thickness. Pouring was done in three stages—6 ft. of concrete with a 72-hour waiting period between stages.

The shaft was filled with 50 ft. of coarse igneous rock, 2 ft. of graded-rock fill, 4 ft. of graded-gravel fill, 4 ft. of graded-sand fill, and 20 ft. of compacted clay. From the top of the clay to the surface, the shaft was filled with bank-run gravel.

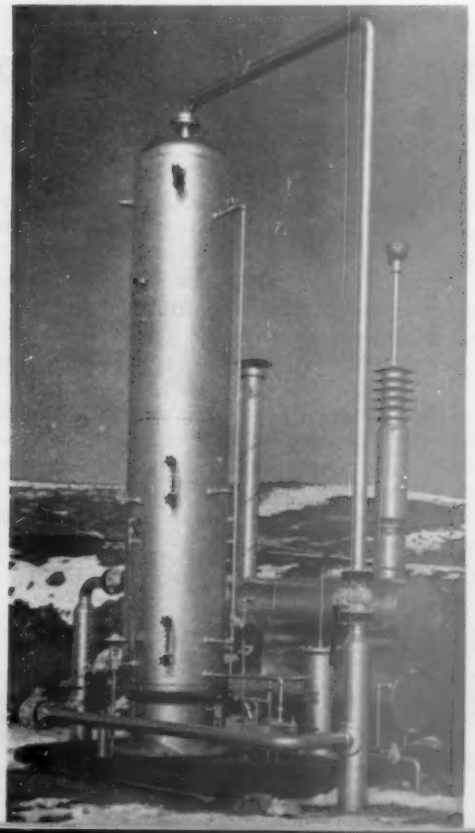
The shaft above the main concrete plug was equipped with a 6⅝-in. mud-supply line terminating in the rock fill between the concrete plug and the compacted clay. Drilling mud, at 14 to 16 lb. per gal., was pumped into the void spaces of the rock fill to act as a sealing agent. The mud line is connected to a reservoir at the surface, so that the hydrostatic head on the rock fill is greater than the expected 300-psig. cavern pressure. The mud reservoir automatically replaces any mud lost into earth strata, and maintains uniform pressure on the system. If losses become excessive, or if additional pressure is needed, lost circulation material can be added to the fluid, and its density can be changed by circulating new mud into the supply line.

Plugging operations in shaft No. 4 were slightly different because of the connection to both the A and B workings. A secondary concrete plug was poured at the junction of the shaft and the A seam in order to effect a seal between the two mines. With this done, the two caverns can be operated as independent storage reservoirs, increasing the flexibility of over-all operations.

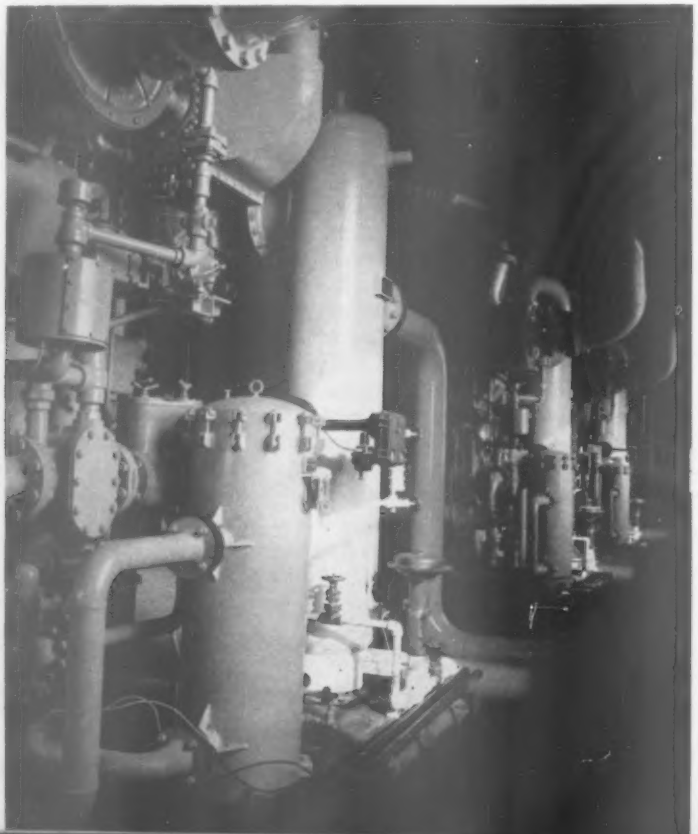
More wells. To facilitate injection and withdrawal of gas, more wells were drilled into the mine caverns, as shown on the map. Two of the wells are being used for dewatering the mine. Well No. 7, equipped with a turbine pump, is dewatering the east workings, and well No. 12, with a submersible pump, is taking water from the west workings. The submersible pump was located in well No. 8 for a time, until the water level got too low, then was moved to its present location after well No. 12 was drilled in a structurally lower position.

Cautious drilling. As pointed out earlier, drilling into the cavern was a fairly hazardous operation since the exact locations of the coal pillars were not known. First wells drilled used a 4-in.-diameter pilot hole to determine whether a favorable location had been chosen. If the bit penetrated the cavern, a bridge plug was set near the mine roof, and the hole was reamed to 13 in. With the bridge plug still in

SEPARATION AND DEHYDRATION is a must at the Leyden project because produced gas is saturated with ground water from the mine.



COMPRESSOR STATION is designed to handle 150,000 M.c.f. of gas per day. It is rated at 7,300 hp. and discharges gas at 175 psig.



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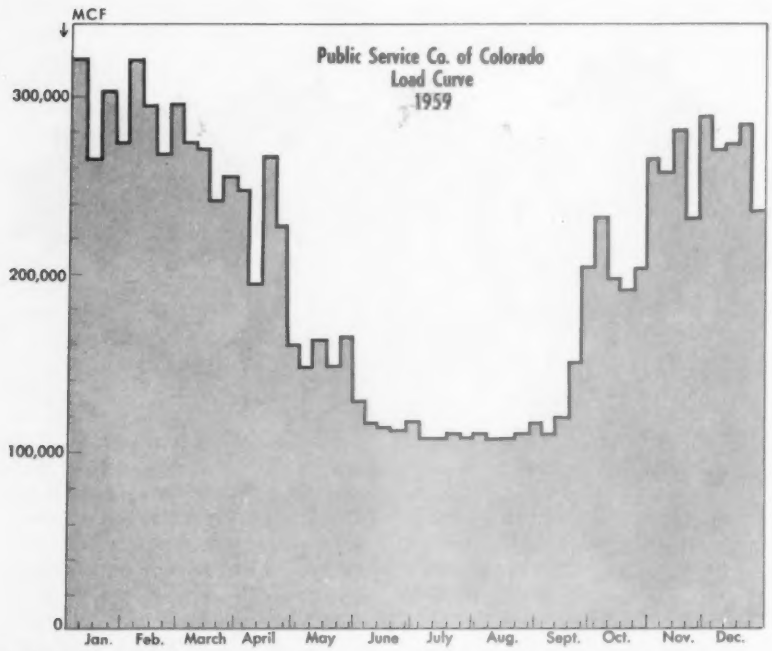

LOAD CURVE for 1959 shows typical seasonal fluctuation of demand for gas in the Denver area. Purpose of the Leyden storage project is to smooth out the peaks and valleys in this curve, and increase the load factor of Public Service Co. of Colorado gas system.

place, 10-in. casing was run and cemented. When cement was set, the bridge plug was drilled out, and the well was ready for gas injection.

On later wells, after more was known about the configuration of the mine tunnels, full-size holes were drilled from the surface, without use of the pilot hole. These wells were drilled to within 20 ft. of the mine roof, and casing was set and cemented. Hole was then deepened to penetrate the tunnel. These later wells were drilled with 9⅝-in. bits and 7-in. casing was set.

Testing. Because of the lack of data on the configuration of the mine tunnels, full-scale dewatering and filling with gas is being done cautiously. As water is pumped from the mine, incremental cavern volumes will be exposed to gas pressure, and these will be tested for leakage. The testing program may last as long as 5 years.

If uncontrollable leakage is found at any point in the dewatering program, water can be reinjected to restore the water seal and the project will terminate at that point. No such trouble is expected now, and it is hoped that full capacity of the mine will be available for gas storage.

Operation. Purpose of this and other storage projects is to provide a nearby source of large volumes of gas during the peak-demand season. Thus, surplus gas will be injected into the mine during the summer months, and withdrawn during the winter months, as needed.

To facilitate these operations, all piping has been designed as a two-way system. The same lines that are used to inject gas into the wells will be used to withdraw the gas.

Big difference is that produced gas will be at a low pressure, and will be saturated with water. For this reason, surface equipment at the Leyden project includes glycol dehydrators and a compressor station. When completed, the compressor station will be rated at 7,300 hp., and will handle 150,000 M.c.f. of gas per day, at 175 psig.

Meter run for the system was designed to operate in both directions also. The meter run, using flange taps, was made long enough so that more than the minimum length of straight pipe is on both sides of the orifice flange. Thus gas being injected and gas being produced is measured with the same meter run. Bellows-type meters are used, one for each flow direction, and the meter not in use is automatically protected from reverse-flow conditions.

Rock catcher. Since complete cleaning of the mine tunnels was impossible because of water, produced gas frequently carries small rocks, pieces of coal, and other mine debris to the surface. This foreign material could cause damage to surface equipment, so a trap was designed to collect all junk before produced gas reaches the meter run.

The trap, called the rock catcher, consists of a section of 12-in. pipe underneath the main 20-in. system line. The smaller pipe is connected to the larger through a pair of tees. Any foreign bodies in the flow stream strike baffles in the upstream tee, and are deflected downward into the 12-in. pipe (see sketch). Further downstream is a mist extractor for removing excess liquid before the gas is metered.

Hydrates a problem. Lower portions of the mine are filled with water, and the walls of the mine are probably dripping ground water at a slow rate, making the produced gas water saturated. Since withdrawals are made during the coldest part of the year, hydrate formation and line freezing is a real problem. Several precautions have been taken to eliminate this problem.

Each well is equipped with a barrel-type drip, and drips are located at all low spots in the gathering lines. A 20-gal. per day methanol injector is located at the extreme well in each gathering system to prevent freezing of any water that gets past the drips, or that may condense in the line. At the rock catcher the reservoir and drip are electrically heated and equipped with automatic 6-in. dump valves. At the compressor station the gas goes through both wetted-type separators and a cyclone-type separator before compression. After compression the gas is dried to a maximum water content of 7 lb. per M.M.c.f. in a glycol dehydrator.

First of its type. Conversion of the Leyden mine to gas storage represents a major pioneering step on the part of the management of Public Service Co. of Colorado. Not a simple undertaking, the decision was made in spite of the risks involved. There were no precedents—no experience to fall back on. And working under water made the job even tougher.

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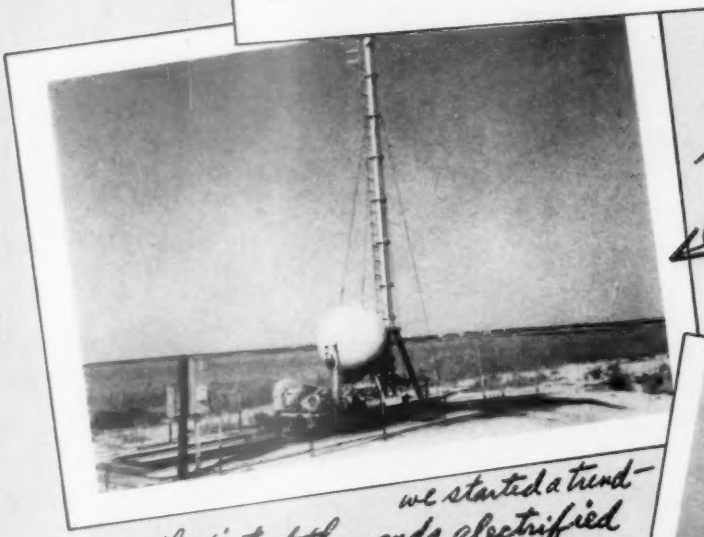

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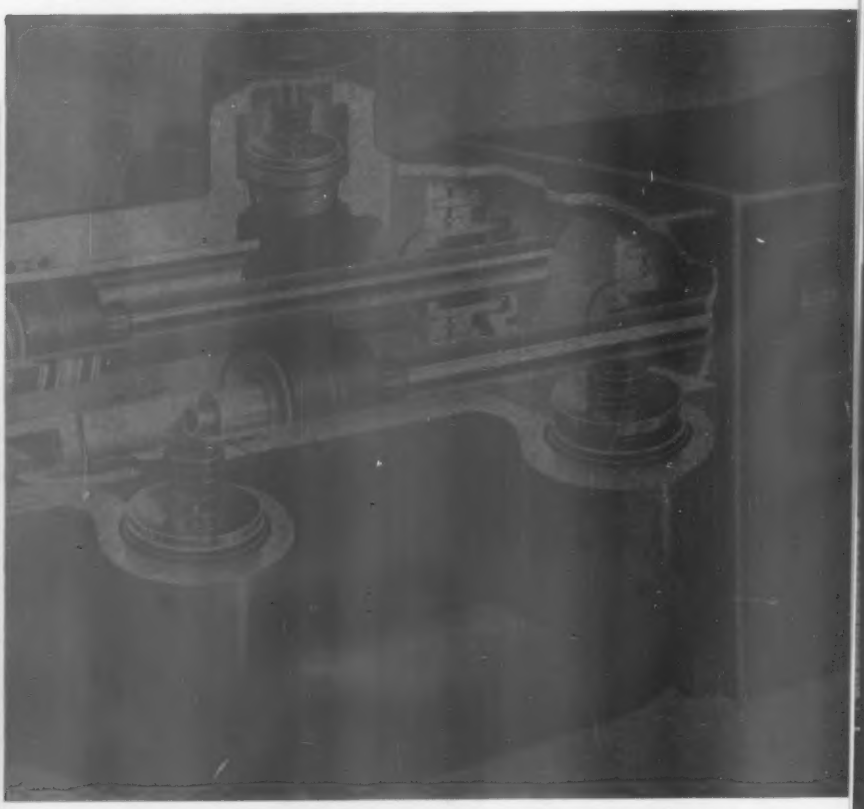

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Its makers say new

"Two-tube" pipe cuts drill-pipe handling, string failures

BY ED McGHEE
Drilling Editor

DRILLING contractors scattered throughout the Mid-Continent and the Rocky Mountains are trying a new type of downhole pipe which, its manufacturer claims, may save money by:

1. Reducing the number of drill collars which the rig must handle.
2. Reducing the frequency of failures in the drill pipe run immediately above the collars.

The new pipe is stiffer and heavier than regular drill pipe. For this reason, the manufacturer says, the new pipe stands up better than ordinary pipe when used in the drill string immediately above the collars. Joints of the new pipe can be handled with tongs and slips in the same manner as regular pipe. Thus, they are faster, safer, and cheaper to handle off the rig floor than are regular drill collars.

The new pipe is sold under the name "Flexweight" by the company, Flexweight, Inc., of Great Bend, Kans. The firm reports that it has equipped some 210 rigs with its new pipe since 1959.

On the outside, the pipe is like conventional API drill pipe. The difference is on the inside. A second pipe is fitted inside each joint. This second tube adds weight and increases stiffness. Result is a joint which weighs roughly twice as much as ordinary pipe but which can still be handled like ordinary pipe.

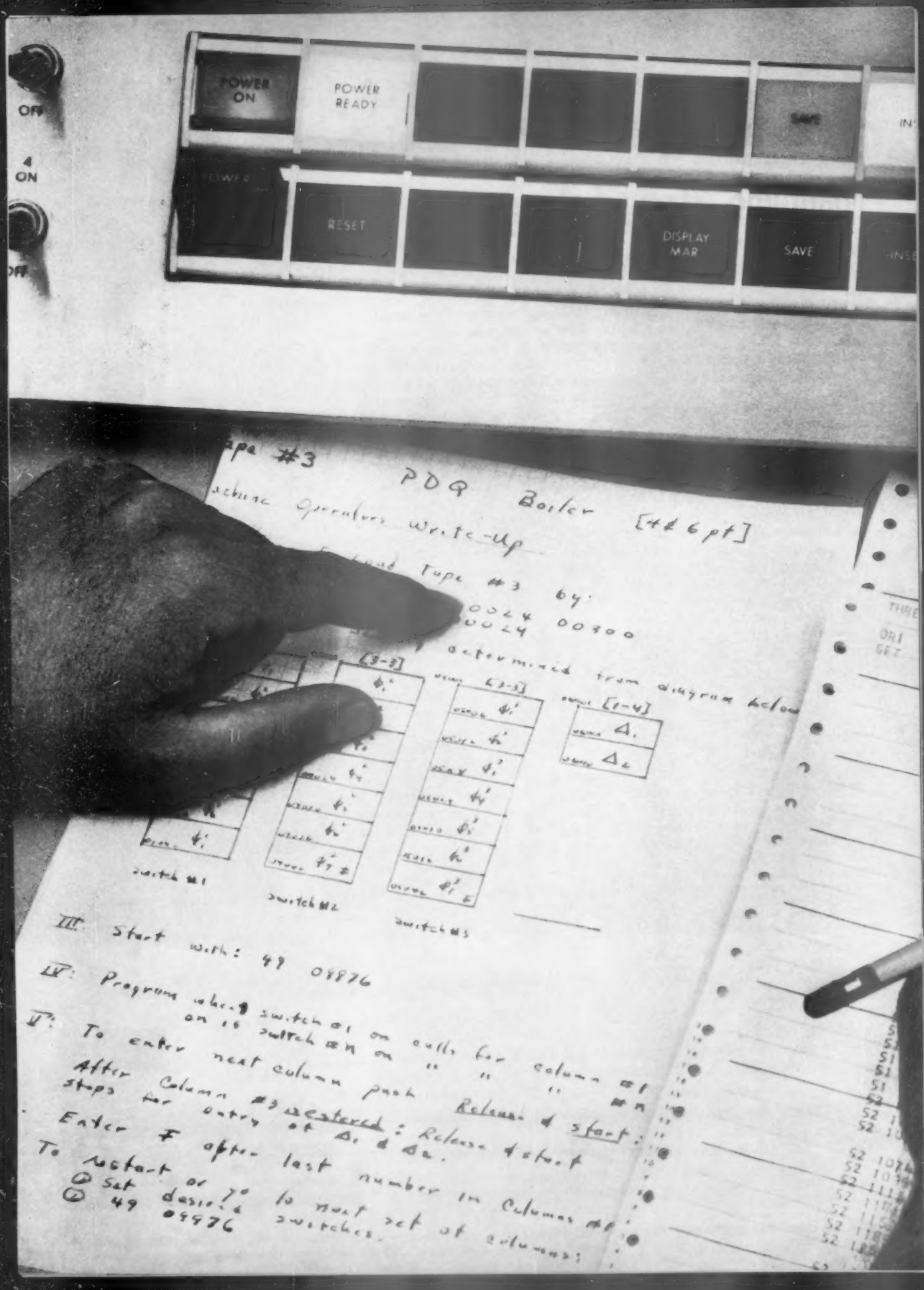
Flexweight engineers do not propose that **all** drill collars can be replaced by their pipe. They do say, however, that the driller can run at least three common drill collars on bottom and economically supply the remainder of bit weight with Flexweight pipe. Flexweight officials contend their product, when used in compression, has a service life that compares well with that of drill collars.

Many contractors are reserving judgment on this point; they are not ready at this time to run anything except drill collars in compression. Running in compression is certainly not recommended as a general practice with ordinary drill pipe. In some areas where drilling is shallow and corrosion fatigue is not critical, drillers often put "pipe" weight" on bit. In such areas it would apparently be an improvement to use the heavier, stiffer pipe.

In deep wells where corrosion fa-

BOTH REGULAR AND TWO-TUBE pipe stand in the mast of Signal Drilling Co.'s Rig 5. Heavier walls insure against failure in string immediately above collars. Fig. 1.

WELD-ON AND SCREW-ON TOOL JOINTS alike may be used on the two-tube pipe. Space between inner and outer tubes is filled with asphaltic material to dampen relative movement. Interference fit between tubes assures that they will not come apart in the hole. Outer tube is normally in tension and inner in compression until run into hole. Fig. 2.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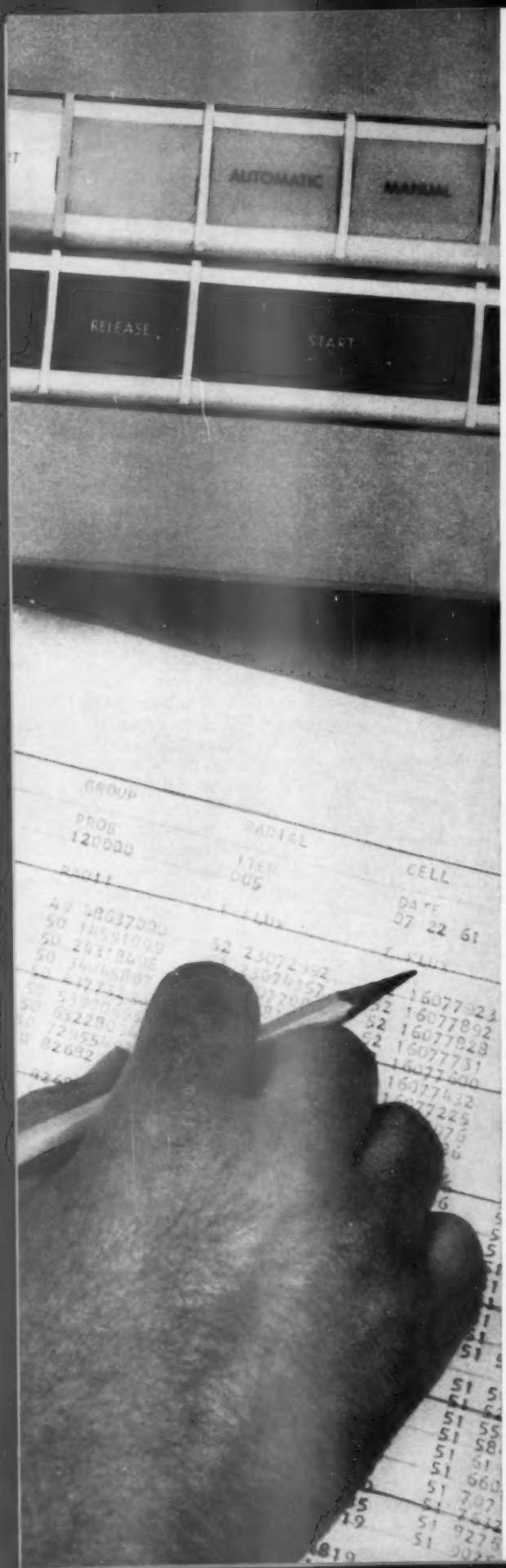
switch #1
switch #2
switch #3
III. Start with: 49 04876
IV: Program when switch #1 on only for column #1
on if switch #n on " " column #n
V: To enter next column push Release & start:
After Column #3 entered: Release & start
steps for entry of Δ1 & Δ2.
Enter F after last number in Columns #1
To restart or ?? to reset set of columns:
① Set desired
② 49 04876 switches.



Cost of one-dimensional criticality computations drops from an average of $75.00 to $7.50 per problem

Faster computing, less travel time are the reasons why General Nuclear Engineering Corporation has realized such cost savings since it installed an IBM 1620 Data Processing System at its Dunedin, Florida plant.

Since its main computing facilities are not located at Dunedin, General Nuclear has found that the new 1620 eliminates much of the travel time and expense involved in taking problems to off-site computers. In addition, the 1620 performs the simpler criticality computations 10 times faster than the computer previously used at one of General Nuclear's off-site data processing centers.

General Nuclear uses its new 1620 for other problems, too...heat transfer calculations, various transient codes, mathematical routines for the physics and engineering departments, multi-group calculations, and many other jobs you might expect only a much more expensive computer to be able to handle.

This isn't all. General Nuclear uses the 1620 to do statistical analyses and variance calculations on input data for programs run on off-site large-scale IBM computers.

For information on this highly versatile, low-cost data processing system, which rents for as little as $1600 a month, contact your local IBM Representative.

Easy to program. FORTRAN, IBM's scientific computer language is available for the 1620. General Nuclear scientists use a special scientific interpretive program—FIDO—written by the Manager of their Computing Section.

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tigue is common, contractors have been slower to use the new pipe in compression. Cost of failure is too great to take unnecessary chances. Thus, a number of contractors report they are adopting a wait-and-see attitude until the new pipe has more widespread and rigorous usage. Some of the same contractors say they can make money using the new pipe even if it is never run in compression. These firms use the pipe just above the drill collars. In situations and areas where twistoffs have been common in the drill pipe just above the collars, the Flexweight pipe, they say, has cut down the number of failures.

As examples. One Rocky Mountain drilling contractor reports successful field use of the new pipe on a recent well. A company rig was drilling surface hole to 400 ft. through rather rough-running formations. In rapid succession there were three pin failures in the drill string, including a kelly-pin failure. It was even necessary to skid the rig and respud the hole.

The second time, Flexweight pipe was used above the collars. This time, there were no drill-string failures and the surface hole was drilled and cased without incident.

A number of Kansas contractors report they find the new pipe safer and faster to handle than drill collars. One firm in the area reports drilling 184,000 ft. of hole with a 34-joint string and finding less twistoff trouble than before. An Illinois contractor reports he finds the Flexweight cheaper to maintain than a corresponding weight of collars.

Interference fit. Construction of the new pipe is simple, as befits any tool which must operate for long periods in the hole. The inner tube is not joined to the outer one by a threaded connection or the like. Instead, the two are held together by a press fit. A special hydraulic press makes possible pressing the parts together with an actual "interference." Result is a tighter bond.

Mating surfaces of the tubes are cylindrical. However, the ends of the outer tube are internally upset. And, one end of the inner tube is expanded. For this reason, the tubes contact only on the ends. The void space in between is filled with an asphaltic material, purpose of which is to dampen motion between tubes.

The two tubes are pressed together in such a way that the outer one remains in tension, the inner one in compression. Thus, if run in compression while drilling, there is less net stress on the outer tube than there would be in an ordinary joint. It is the outer tube which carries all weight. The inner one simply adds weight and stiffness.

Outer member is API drill pipe in sizes 4-in. diameter and larger. Inner member is nonupset steel tube. Table 1 shows some of the sizes available and how their weights compare to regular drill pipe.

Screw-on tool joints are applied to the pipe after assembly, and flash-welded joints before assembly. Either screw-on or weld-on joints may be used.

It is customary to hard-band the tool joints used on the new pipe. If the pipe runs in compression, the tool joints doubtless are subject to more abrasive wear than are tool joints on pipe run in tension. The joints can be rehardbanded in the field as required.

Some engineers feel that the tool joints on the new pipe should last better than do the joints on drill collars. Reason is that the new pipe is not too stiff to bend in the body of the pipe; drill collars ordinarily bend only in the joints. Result is heavier loading and, perhaps, shorter life for collar joints.

Field use. Flexweight recommends from 10 to 40 or more joints for the individual drill string, depending on the job to be done. The company says that the pipe provides drill-bit weight and drill-stem length in a ratio that reduces total weight and cost of the string. Table 2 compares weight and cost of two strings, one with the new pipe and one without. The strings are 6,000 ft. long and designed to drill 7⅞-in. hole with 50,000 lb. (air weight) on bit.

Table 2 shows a weight reduction of 6.8% and a cost saving of 2.7% for the string in which Flexweight pipe replaces some of the drill collars.

While stiffer than regular pipe, the new pipe is still more limber than regular drill collars. It is for this reason that the manufacturers do not recommend running the new pipe immediately above the drilling bit.

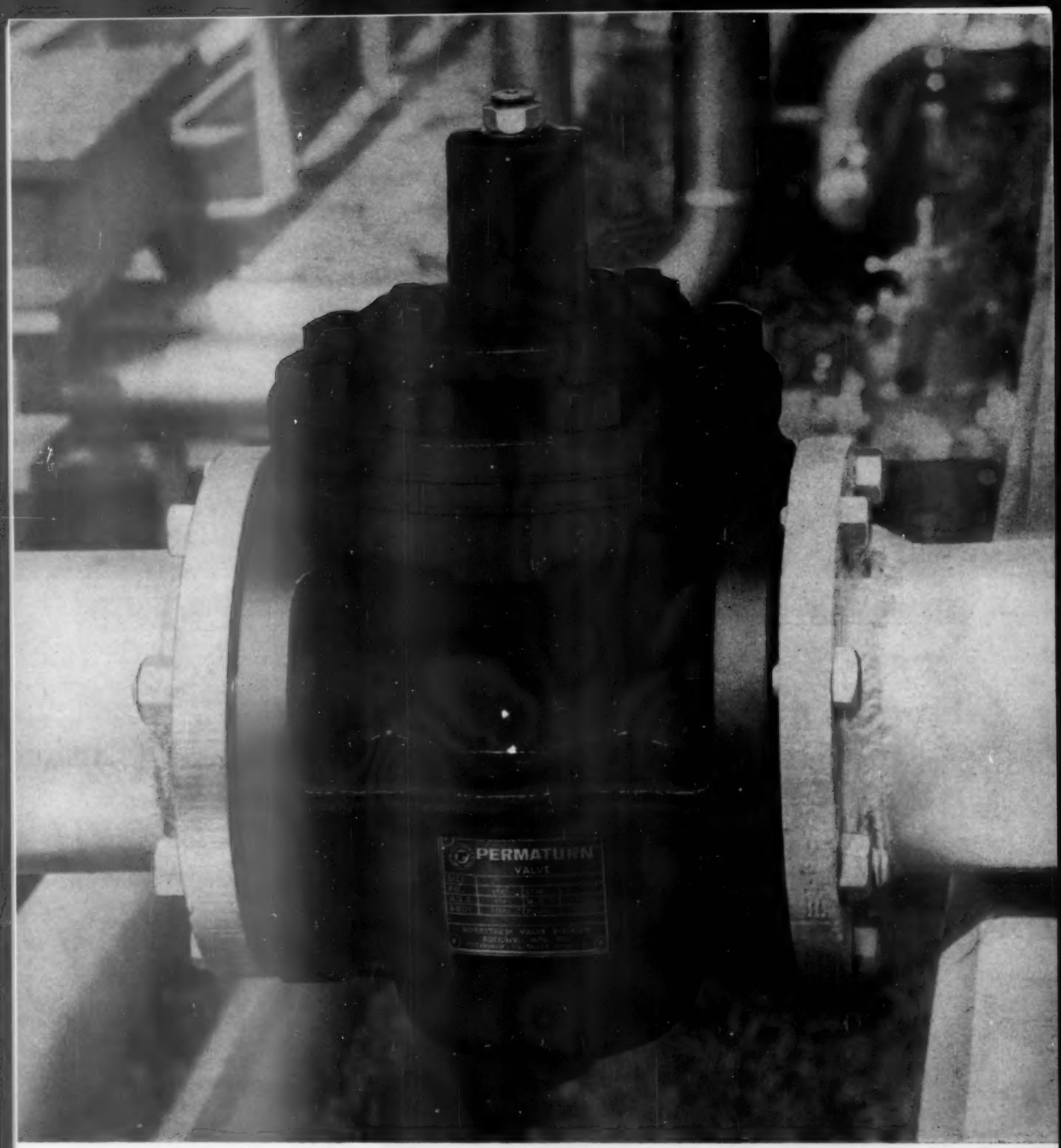
While the new pipe has larger internal diameter than do regular drill collars, a greater footage of the pipe is required to furnish a given weight on bit. For this reason, mud-pressure drop through the Flexweight may sometimes be higher than through a corresponding length of collars. Usually, however, the extra pressure loss is not critical in figuring hydraulics for jet-bit drilling.

Table 1—Joint weights with weld-on tool joints

Assembled components							Completed assembly	
Drill pipe		Inner tube		Tool joint				
Size (in.)	Wt./ft. (lb.)	Size (in.)	Wt./ft. (lb.)	O.d. (in.)	Size (in.) and type		Size (in.)	Wt./ft. (lb.)
4	14.00	3½	11.00	5¼	4	API FH	4	28.25
4½	16.60	3½	13.30	6	4½	API FH	4½	34.00
4½	20.00	3½	13.30	6	4½	API FH	4½	37.00
5	19.50	4	14.00	6⅜	5	XH	5	37.50
5½	21.90	4½	16.60	7	5½	API FH	5½	44.00

Table 2—Weights, costs 6,000-ft. drill strings

Conventional			
4½-in. IUE drill pipe with 6-in. o.d. Flashweld tool joints attached	5,370-ft./	97,733 lb.	$31,772.68
(21) 6-in. o.d. by 2¼-in. i.d. drill collars	630-ft./	52,038 lb.	13,986.00
Totals	6,000-ft./	149,771 lb.	$45,758.68
Flexweight			
4½-in. IUE drill pipe with 6-in. o.d. Flashweld tool joints attached	4,680-ft./	85,175 lb.	$27,690.16
4½-in. 37-lb. Flexweight drill pipe	1,200-ft./	44,400 lb.	14,172.00
(4) 6-in. o.d. by 2¼-in. i.d. drill collars	120-ft./	9,912 lb.	2,664.00
Totals	6,000-ft./	139,487 lb.	$44,526.16



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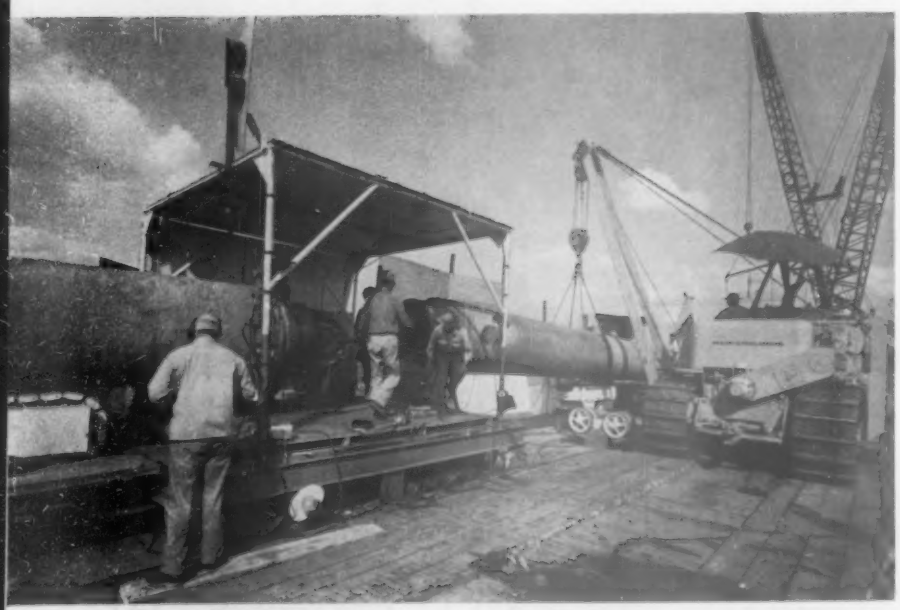
THESE FIVE BARGES are combined into the John Mecom Lay Barge No. 1, believed to be the longest lay barge ever assembled. It is laying 60 miles of 36-in. line with up to 4½-in. of concrete jacketing in Louisiana marshlands.

Five barges combined in one for heaviest pipe-laying job



A SIDEBOOM TRACTOR moves a joint of pipe to one of the six welding stations. The first station applies the stringer bead and hot pass while subsequent stations add the required number of filler passes.

SOME of the heaviest, most thoroughly protected and costliest pipeline on record is being laid on the Louisiana Gulf Coast.

It is a 36-in. line, just under 60 miles in length. United Gas Pipe Line Co. is installing the line from its Lirette, La., station to the prolific Bastian Bay field. It is the largest line ever laid through the Louisiana marshland.

The superlatives are fully justified by the job the line will do. It will connect United's system with a large part of the huge volume of known recoverable reserves.

Contract in the field with Gulf Oil and Tidewater cover reserves presently available to United. In addition, United, which already handles more gas than any other pipeline company in the world, will be in position to tap new reserves in the area as they are discovered.

United has contracted with Pan-

ama, Inc., of Houston, to lay the line. Panama has assembled what is believed to be the largest lay barge ever used, the John Mecom Lay Barge No. 1, to do the job.

Combines five units. It consists of five barges coupled together. They add up to a total length of approximately 550 ft. The unit as a whole has four equally spaced sets of spuds which are let down to hold the barge in place after it is moved from one station to the next. The unit is pulled by a single 600-hp. tug.

The lay barge has eight welding stations though only six are in use. It takes 21 joints to fill the sleeve at the welding stations. The first station applies the stringer bead and hot-pass welds and the subsequent stations the filler passes. One station is equipped with X-ray facilities and all welds are X-rayed.

The pipe is 0.500-in. wall thickness, X-52 grade, manufactured at the Orange, Tex., plant of American Bridge Division of United States Steel Corp. It is the heaviest pipe ever manufactured at the Orange plant. Each 40-ft. joint weighs approximately 7,500 lb.

Coated at plant. The pipe is being coated at the Rosson-Richards plant on the New Orleans industrial canal. It is coated with coal-tar enamel and up to 4½ in. of reinforced concrete is used for jacketing. This increases the weight of the pipe to 870 lb. per foot, or 17 tons per string.

The 4½-in. jacket of reinforced concrete is being applied to the 19 miles of the line that will be laid in the open water of the canals, bayous and bays that have to be crossed. On the remaining 40 miles of open marsh country, 3½ in. of concrete will be used. This pipe will weigh about 700 lb. per foot or 14 tons per joint. Less than 1 mile of the entire ditch could be dug by a drag line operating on mats.

This massive coating limits deflection in the pipe to a maximum of approximately 1 to 25 which necessitates particular care in handling the pipe. As M. E. (Panama) Shiflett, president of Panama, Inc., put it, "every step of the job had to be engineered."

The barge is staffed by a crew of 74 men per 12-hour shift, a total of 148. It is a hand-picked crew with none having less than 12 years' experience. Working around the clock is made possible by one barge which, in addition to an air-conditioned galley, has five generators for producing electric power

Dredges used. Another unusual feature of the operation in addition to the oversize lay barge is the use of as many as 13 dredges at one time to dig trench. They have operated as much as 20 miles ahead of the lay barge.

The dredges dig a ditch 50 ft. wide and 12 ft. deep for flotation. The pipe trench is then ditched to 19 to 20 ft. Finally the pipe is jetted to grade. When it is laid, the line will have 12 ft. of cover. The dredging job was subcontracted to Sam Carline, Inc.

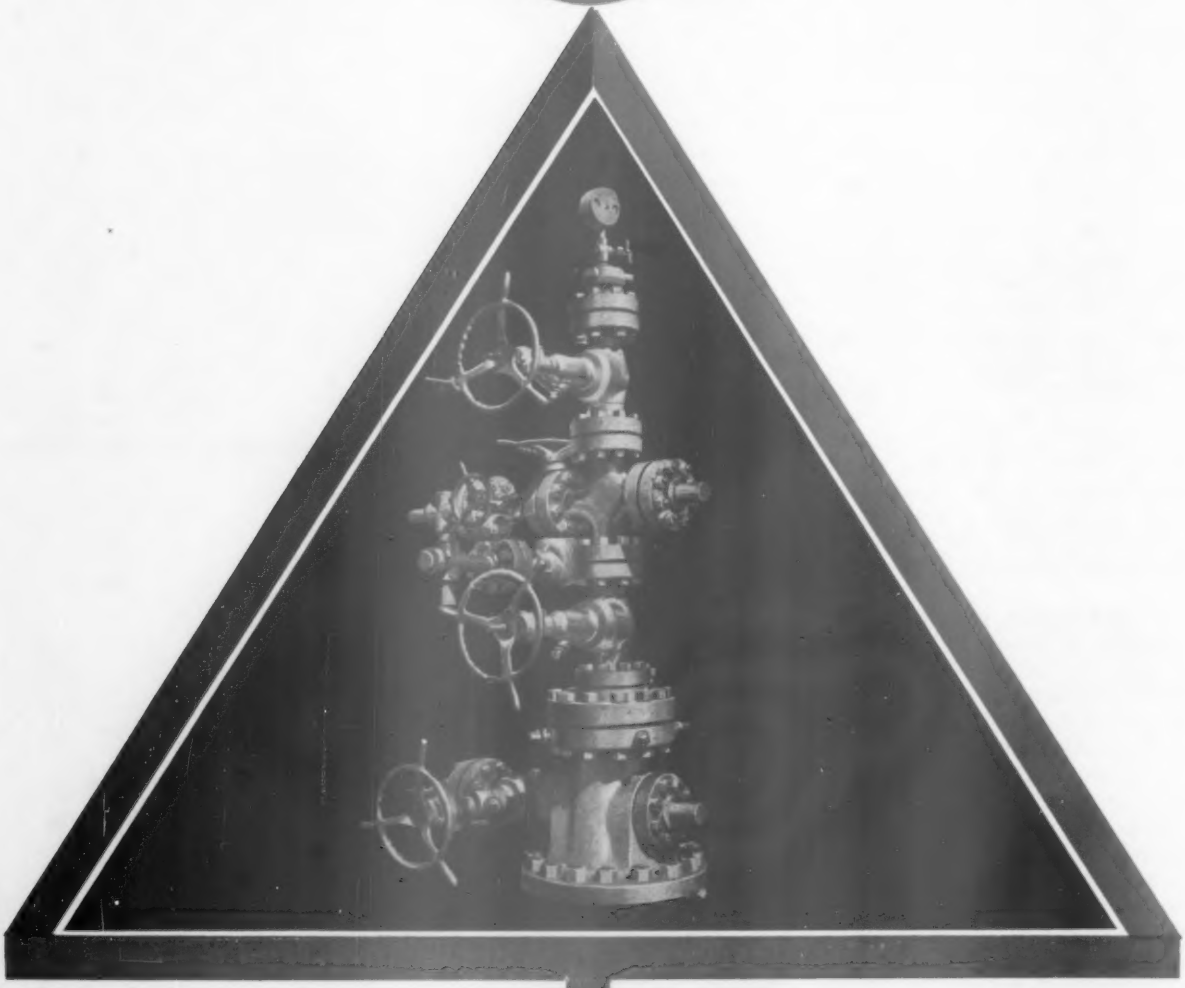
Some of the 13 dredges and six 300 hp. to 600 hp. tugs are owned by John Mecom, part owner of Panama, Inc. They are normally used in Mecom's offshore drilling operations and were made available for the Lirette-Bastian Bay undertaking.

The barge was laying line at the rate of 3,800-4,000 ft. per day. As of November 27, approximately 42 miles had been completed and slightly less than 18 miles remained to be done.

Total cost of the job will be approximately $27 million. This averages out to almost $285,000 per mile.

ONE OF THE 13 DREDGES that were used to dig trench for the Lirette-Bastian Bay line of the United Gas Pipe Line. They first dredged a 50-ft.-wide trench 12 ft. deep, then cut a 19 to 20-ft. pipe trench. Line was finally jetted to grade.

ORBIT VALVES®



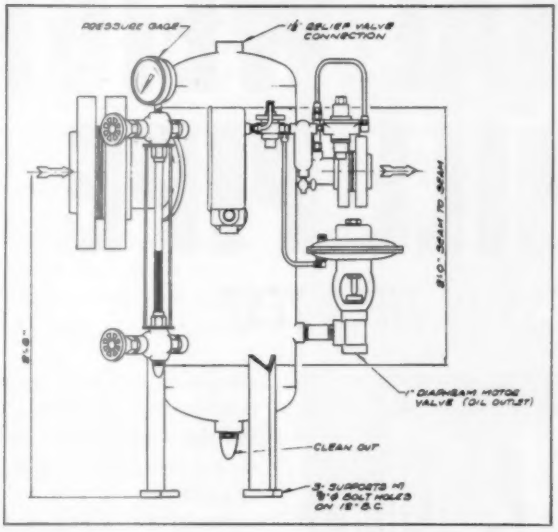
WE'D LIKE TO BE . . . ON YOUR CHRISTMAS TREE

This is the season in which to remember . . . and be remembered.

Orbit Valve Company's personnel — wherever they may be — appreciate the opportunity of serving a truly great industry during this year and the many years of the past.

We sincerely wish a Happy and Prosperous New Year for everyone throughout the oil industry.

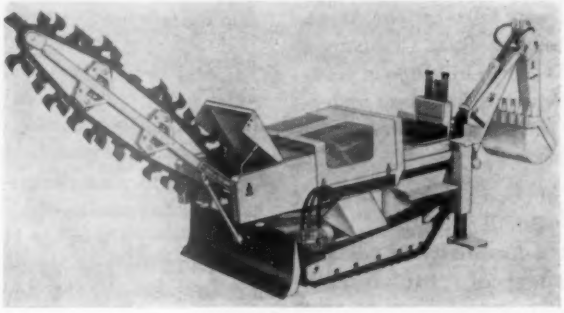
ORBIT VALVE COMPANY • TULSA, OKLAHOMA


PRESSURE GAGE
½" RELIEF VALVE CONNECTION
8'-0"
8'-0" SEAM TO SEAM
1" DIAPHRAM MOTOR VALVE (OIL OUTLET)
CLEAN OUT
3" SUPPORTS W/ 3/4" BOLT HOLES ON 18" B.C.

Portable separator scrubber

A NEW separator-scrubber using the principle of centrifugal force in the separation of oil and gas has recently been announced. Called the Oil Patcher, this unit has been engineered to separate entrained liquid, dust, and dirt, and to meet all flow and pressure requirements. The separator scrubber works equally well when separating high-oil, low-gas ratios, or high-gas, low-oil ratios.

Compact and portable, the unit does not depend on retention time within the vessel for separation. Source: **Centrifix Corp.,** 1017 Lehall, Houston 25, Tex.



Trencher with backhoe attachment

THIS T-78 TRENCHER and dozer with backhoe is designed for handling all soil conditions and digging assignments from 3 to 36-in. wide and to 8 ft., 4-in. deep. It completes the job by backfilling and leveling to the final grade. With this combination you can handle normal trenching assignments up to 18-in. wide, then turn the unit around and employ the backhoe to dig bellholes, laterals, septic tanks, connecting lines, or use it to trench in rocky areas. The hydraulically controlled dozer, an integral part of the trencher, can level deep-rutted areas to provide a smooth surface for effective trenching, the maker claims.

The trencher operates at speeds up to 840-ft. per hour, from 3 to 18-in. wide to 78-in. deep. It has a 10-in. conveyer belt which can be set to deliver spoil to either side of the ditch. An 18-hp. Wisconsin engine drives the digging system and provides power to a hydraulic motor that activates a 2-speed transmission. This provides a variable-speed ditching control, while giving the trencher fast forward or reverse mobility. Source: **Davis Mfg. Inc.,** 1500 S. McLean Blvd., Wichita 13, Kans.

●

Insulating gasket for ASA flanges

A new gasket, said to assure no-leakage sealing plus effective electrostatic insulation, has been placed on the market. Series 6500 gaskets combine insulating material with the controlled-confinement principle of the maker's Gask-O-Seal gasket seals. This principle provides full metal - to - metal contact of faying surfaces and prevents crushing of the seal itself. The seal cannot cold-flow or be squeezed out by pressure, the manufacturer claims. The reuseable Gask-O-Seal is said to be especially useful in high-pressure systems. Source: **Parker Seal Co.,** 10567 W. Jefferson Blvd., Culver City, Calif.

Want more facts about equipment or copies of product literature described in this issue?
Send this coupon
to manufacturer at address shown after each item.
Product name, Model no., literature title or number: ----------
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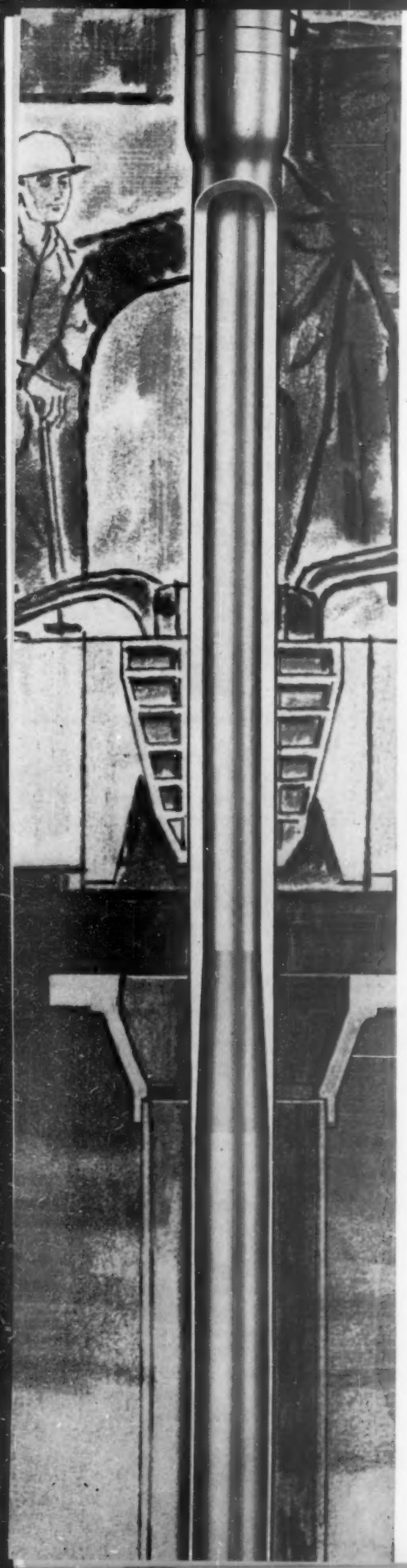
Described in OIL AND GAS JOURNAL-Issue of December 18, 1961
NAME ---------- TITLE ----------
COMPANY ----------
ADDRESS ----------
CITY ---------- STATE ----------



PITTSBURGH STEEL REPORTS ON...

DUAL WEIGHT DRILL PIPE

SUCCESS IN FIELD TEST

In West Texas, South Louisiana, Oklahoma and out on the West Coast, Pittsburgh Steel Company's new Dual Weight Drill Pipe is proving itself the way drillers best understand—by performance under actual field conditions.

Dual Weight is a completely new type of drill pipe developed and produced exclusively by the manufacturer of "Pittsburgh Seamless."

It provides drillers an integral combination of strength and light weight never before available in popular API grades and sizes of drill pipe.

Drilled footage on four strings of Dual Weight now stands at better than 100,000 feet—every inch of it under normal rotary drilling practices.

Results? Excellent—better than expected in some cases.

Field tests are continuing. Additional strings are being placed in service on drilling operations specifically selected to prove out Dual Weight's advantages and performance under the widest possible range of drilling conditions.

But, so far, here's what experience shows Dual Weight does:

- Cuts drill string weight.
- Increases rig depth capacity.
- Increases slip area strength up to 20 percent.
- Boosts hydraulic performance.
- Effects lower maintenance costs and longer service life on rig equipment.
- Cuts transportation costs.
- Increases drilling rates and speeds up round-trips.

• **What is Dual Weight?**—First of all, it's one of the most important developments in rotary drilling in many years. It's an entirely different type of drill pipe design—although it looks the same as other drill pipe. The difference is in the ID.

Look at the cutaway sketch at the left of this page. It shows Dual Weight's design features.

Notice the box end. Below the tool joint and upset, it has at least four feet (but not more than six feet) of heavy wall steel in the critical slip area. Then, a gradual, uniform internal taper makes transition to a light wall body that extends the remainder of the joint's length.

Some drillers refer to the heavy wall at the box end as a "long upset"—a good description, but inaccurate. The heavy wall is produced

by a patented process that bears no resemblance to upsetting.

Drillers can benefit two ways with Dual Weight.

If it's a lower hook load they want, then thin wall Dual Weight meets the need. It combines the strength of standard pipe in the slip area, and the weight saving of lighter weight pipe in the body.

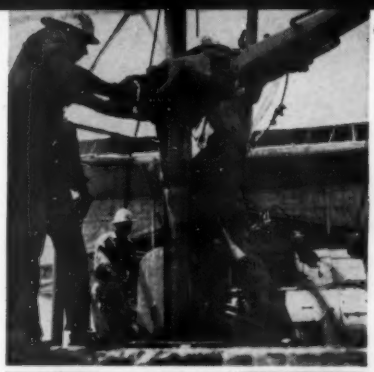
Or, if extra strength and safety—rather than lower weight—are required, Dual Weight again is the answer. In this version, it has a standard wall body and an extra heavy box end with a safety factor

near or equal to the safety of the body.

• **Strength?**—Either way, Dual Weight has it—in the slip area where it's needed to resist the notching, crushing, crimping, stretching and bending forces it is subjected to.

Light weight? Its thinner wall body eliminates pounds per foot over 85 percent of the length of a 30-foot joint.

For example, 4½-inch Dual Weight with a .337/.254-inch wall weighs 16.60 lb./ft. for 15 percent of its length (the box end) and 13.25 lb./ft. for 85 percent of its length (the body).



And don't overlook hydraulic performance. The larger ID resulting from Dual Weight's thinner body wall lets pumps push more mud at lower pressures. There's more energy applied at the bit. Penetration rates are higher and returns are better.

But here's a sample of how drillers themselves benefit from Dual Weight.

A Large Independent Oil & Gas Drilling Corporation—drilling shallow wells in West Texas with 6,000 feet of 4-inch (.330/.254-inch wall) Grade E Dual Weight.

A Drilling Superintendent—"I believe Dual Weight is the only thing for a little rig. Its lighter weight means less wear and tear on the rig and equipment. And when you move as often as we do, there's quite a saving on trucking charges. Any time we can get away from handling weight, we're better off."

A Veteran Tool Pusher—"We save trip time because we can come out of the hole faster. With less weight we get more rpm's. We save fuel, too, because our engine isn't working as hard."

• A major oil company, drilling deep wells in Louisiana with 15,000 feet of 4½-inch, (.337/.271-inch wall) Grade E and P-95 Dual Weight.

A company drilling engineer said: "We're looking for higher velocities and larger volumes of fluid at equal pump pressures from Dual Weight. We know we're getting better hydraulics—moving more fluid.

"In deep drilling with high mud weights, you get better penetration with increased bit hydraulic horsepower. We calculate we're getting a 25 percent increase in BHP."

Interested in more detailed information? Write for literature, or contact a Pittsburgh Steel district sales office or one of the independent distributors listed below.

Distributor Home Offices

Atlas Bradford Company
Houston, Texas

Bennett Supply Company
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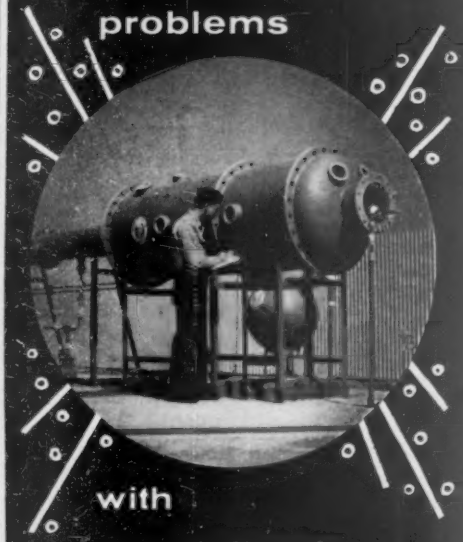

with specialized peerless methods and equipment

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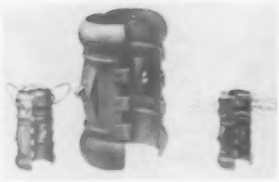
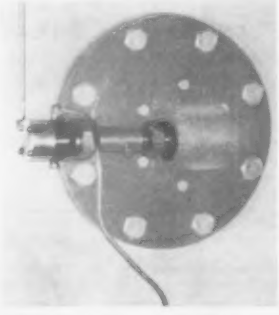


Spacer for tubingless completions

A positive spacing of ½ in. between strings in dual or other multiple-string completions can be obtained with a new device, called a Spacelizer, made of steel which uses a tubing-size automatic stop collar with steel rings welded to each end. When the space equalizer is properly installed, it will separate each string so that one string can be run past the other without a hangup.

The basic unit also comes in three other models as combination units designed to provide added cement spreading action, and conditioning of the drilling fluids.

Available in all common tubing sizes, each model of the tubingless-completion equipment has a holding strength of more than 17,000 lb., the maker claims. Source: **B & W Inc.,** 19706 S. Normandie Ave., Torrance, Calif.



Rotary pilot controls dump valves

The 12 RP rotary pilot, for controlling liquid dump valves, mounts directly on float trunnion shafts and eliminates all mounting brackets and linkage. Incorporated in the pilot is a liquid-level adjustment and an adjustment for spread in level. The pilot permits a minimum float travel of 8° to a maximum of 90°. Pressure outlets are provided for direct or indirect action and single or double action. Maximum supply pressure is 125 psig. Source: **Kimray, Inc.,** 52 NW 42nd St., Oklahoma City, Okla.

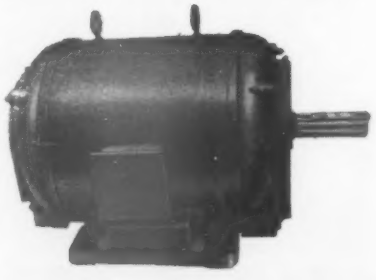
For Uninterrupted POWER FLOW in the OIL FIELDS

You Can Rely on

FIELDMASTER

ALL WEATHER

BALL BEARING MOTORS



Available in SEMI and TOTALLY enclosed models, with special high temperature Class "B" or better insulation in **all critical** parts, and with Stators double dipped with Class "F" special insulating varnish which provides an **especially effective resistant** to heat, aging and moisture.

Yes, you will find FIELDMASTER MOTORS unusually efficient in overcoming **all** adverse conditions because they are

- **MOISTURE PROOFED**
- **VERMIN PROOFED**
- **CORROSION RESISTANT**
- **SEALED TERMINAL BOX**

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BETHLEHEM STEEL CO.

SUPPLY DIVISION

TULSA, OKLAHOMA

Manufactured By
Valley Electric Corporation, St. Louis 8, Missouri

SQUEEZE CEMENTING WITH FIRST TIME DEPENDABILITY

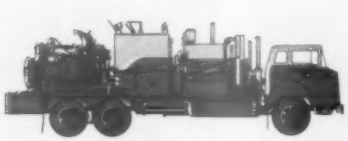
Downtime is no time for wasting time. When Halliburton is performing your squeeze cementing job you expect the job to be done quickly, efficiently, and *thoroughly*. All the care and skill at our command are used to help produce successful squeeze cementing results for you the *first* time. Whether you are squeezing perforations to isolate a payzone, repairing a casing leak, sealing a low pressure thief zone, plugging to abandon a zone or well, or correcting a channeled primary job, depend upon Halliburton's experience spanning over 35 years of successful squeeze cementing.

DM/DC SQUEEZE PACKER
designed for first time dependability

DM/DC Squeeze Packer

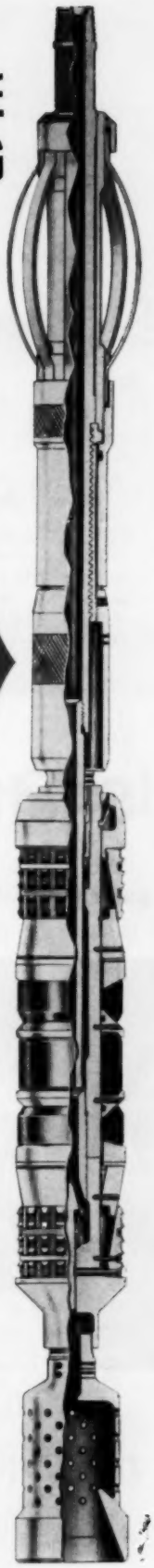
Compare these operator-approved features with any other squeeze packer:

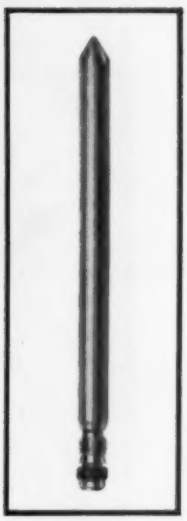
- *Built-in Back Pressure Valve* – keeps tool open for circulation or reverse circulation at any time while running in. The valve closes after packer is set to shut off back flow. Sealing cup-type valve affords a more positive seal.
- *Free from Packer* – Circulating Valve and tubing are free from packer before squeezing begins and may be picked up between stages as desired. Tubing and Circulating Valve may be withdrawn from the well at any time to repair a tubing leak and then re-enter the packer.
- *Multiple Setting Techniques* – tool may be run and set on tubing, drill pipe, sand line, drilling line, or electrical logging wire line.
- *Convertible to Bridge Plug* – easily, efficiently. A Permanent Sealing Plug may be installed in the tool at the surface . . . a 15/16" bridging ball or Sealing Plug can be dropped down the tubing into a seat in the packer . . . or a Shut-Off Sealing Plug which shuts off in the packer may be pumped down the tubing behind cement and ahead of displacing fluid to help prevent cement contamination.



See your Halliburton man for tools, techniques, and materials designed to help solve your squeeze cementing problems. Call him today.

275 Service Centers . . . just minutes away from your well





Weighted Sealing Plug

Shut-Off Sealing Plug

Permanent Sealing Plug

CEMENTING SERVICES

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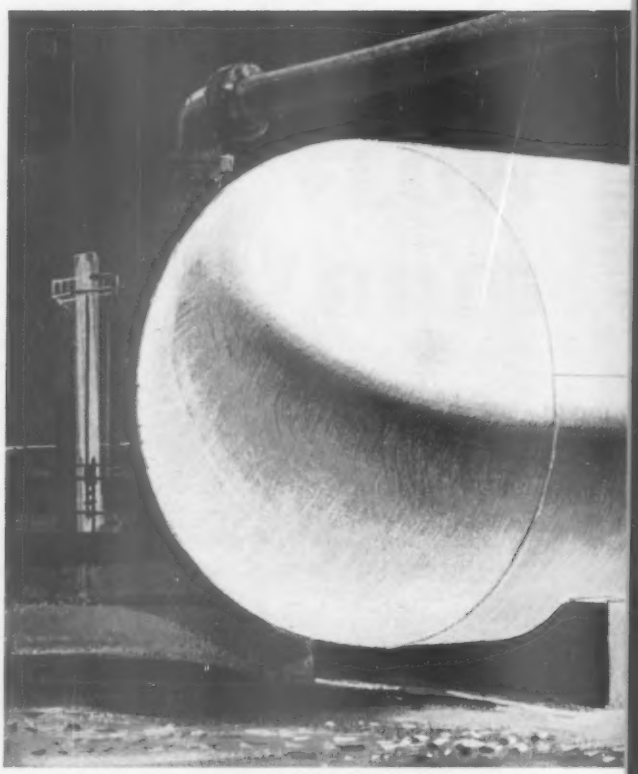


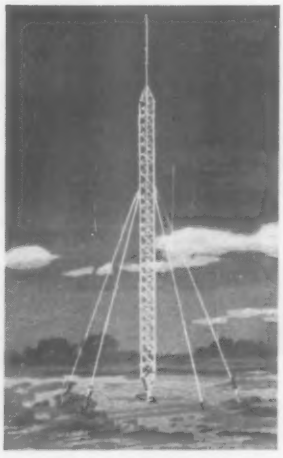
SSS 100 ALLOY STEEL

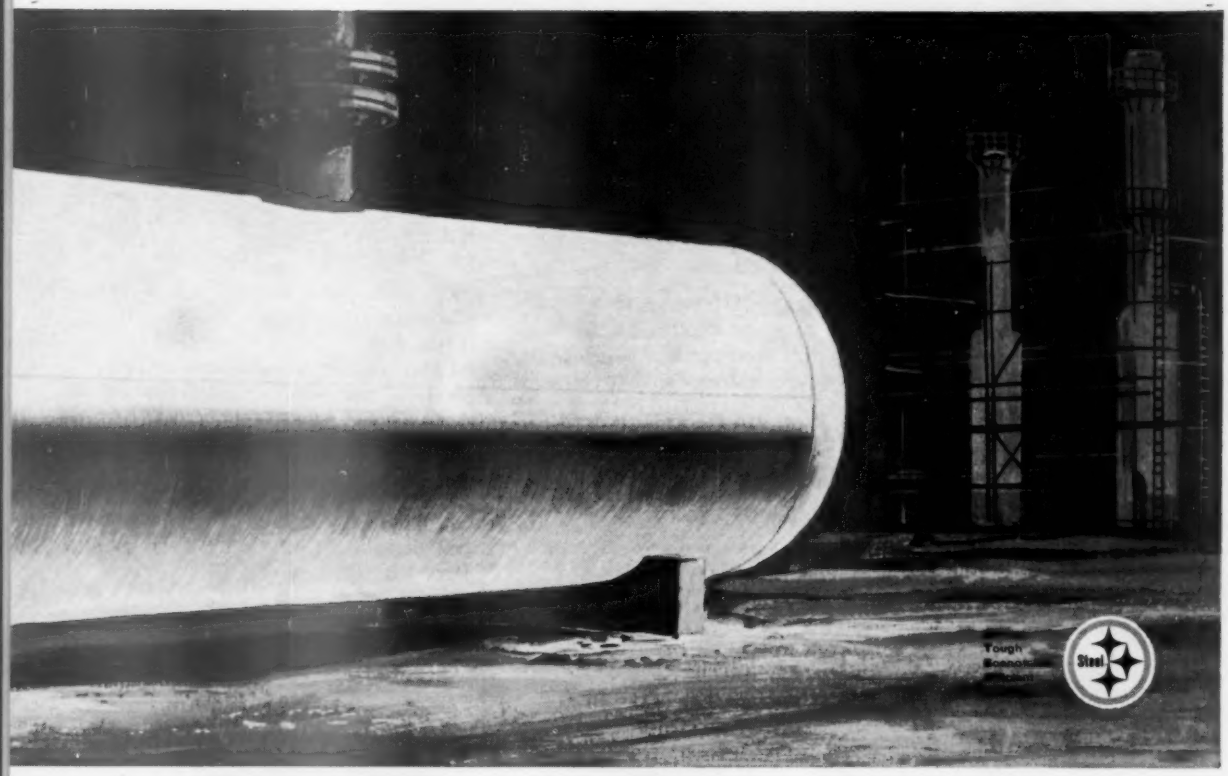
A.S.M.E. Approved

SSS-100 is approved for use in the construction of welded pressure vessels according to the requirements of Section VIII of the ASME Boiler & Pressure Vessel Code (Case No. 1298—Special Ruling).

Sheffield's New SSS-100 Meets

(Triple S-100)





Growing Need For Tougher Steel

Quenched and Tempered Alloy Constructional Steel With New Weight-Saving Strength—Greater Durability Under Punishing Loads—Excellent Weldability for Easier Fabrication.

Here it is! Sheffield's answer to the challenging need for steel with new qualities to meet the pressures of today's construction:

New Sheffield SSS-100	
Tensile Strength	115,000 psi minimum
Yield Strength	100,000 psi minimum
Elongation (in 2 inches)	18% minimum
Reduction in Area	50% minimum

SSS-100 may be furnished to requirements of ASTM A-300 at –50°F in firebox or higher quality levels.

SSS-100 is the steel to specify—to demand—for storage tanks and pressure vessels, bridges, earth movers, heavy construction machinery, transport equipment, tank trucks, TV towers, fabricated structural shapes, missile ground-support equipment—any application that calls for a versatile combination of high strength, toughness and excellent weldability.

Sheffield SSS-100 is available in plates from $\frac{3}{16}$ to 2 inches thick, in blooms and billets for forging and subsequent heat treatment. Heat-treated bars can be furnished on inquiry. Also supplied heat treated to 321 minimum Brinell for use where resistance to impact abrasion is required.

For complete information and technical service, write **Sheffield Division, Armco Steel Corporation, Attention Alloy Sales, P. O. Box 3129, Houston 1, Texas.**

ARMCO Sheffield Division

Gelatinizer for oil and oil mud

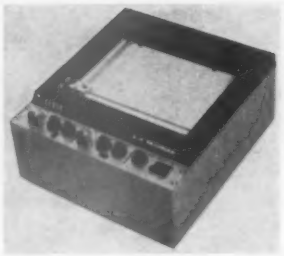
A temperature-stable organophilic colloid has been developed for gelling oils and oil mud so that all solids, including weight material, can be suspended and top separation of oil will not occur. The product, Geltone, is almost white in color and comes in dry powder form.

Its uses include the imparting of gels to field crude oil and diesel oil for drilling in, completing, and working over low-pressure wells, conditioning of mud for long-time storage in casing-tubing annulus or tanks, and the conditioning of weighted oil mud to free stuck pipe. Source: **Baroid Div., National Lead Co.,** Box 1675, Houston, Tex.

●

Latest X-Y recorder introduced

Designed for use where two variables must be plotted at the same time, this recorder is a null-seeking, servo-type instrument that responds to two simultaneous d.c. input voltages and plots curves in ink in Cartesian coordinates on 8½ by 11-in. paper.



The recorder is available in two models: one with a sensitivity of 1 mv. per in., the other with a 10 mv. per in. sensitivity. The instrument is equipped with pen, pen carriage, combination ink bottle and filler, and pen cleaner. Source: **Central Scientific Co.,** 1700 W. Irving Park Rd., Chicago 13, Ill.

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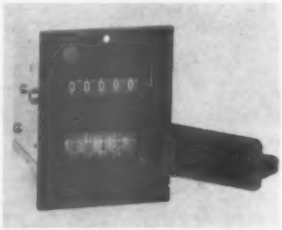


Predetermining electrical counter

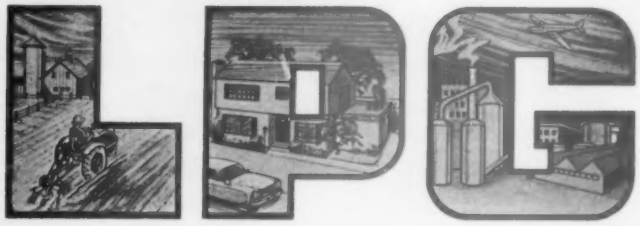
This panel-mounting adding predetermining counter (Model F 185) with push-button reset provides visual wheels which give constant progress count. Presetting is carried out by means of a parallel set of wheels underneath the hinged cover. When the preset count is reached, a knockoff switch is thrown. Count rate is 25 per second. Panel dimensions are 2½ by 3⅜ in. Source: **Presin Co., Inc.,** 2014 Broadway, Santa Monica, Calif.

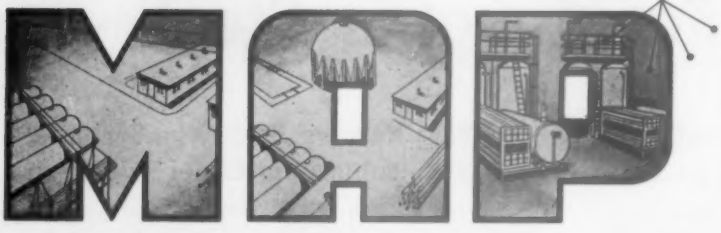
●

New abrasive mixer

Instant control by an operator, either manually or automatically, saves the most expensive item in blasting, the abrasive. This blast machine is held under pressure at all times, thus eliminating waiting for

PUT YOUR LPG ON THE MAP





. . . for faster, more dependable delivery

This year, avoid uncertain deliveries and artificial shortages. Arrange to have your LPG shipped via Mid-America Pipeline. Bad weather can't block shipments on this underground highway; can't even slow them down! Eight conveniently-located delivery terminals (with a ninth under construction) serve the entire upper midwest.

Do your Distributors and Customers a favor — put your products on the M.A.P.* call —

MID-AMERICA PIPELINE COMPANY

1437 SOUTH BOULDER AVE. • TULSA, OKLAHOMA

the pot to pressurize. The Abrasive-Miser makes moving around on scaffolding easier and safer without losing time signalling to the pot tender. It will fit onto any blast hose in minutes and no time is wasted re-piping the pot or making connections. Source: **L. C. Nesham Products,** Box 641, Allentown, Pa.

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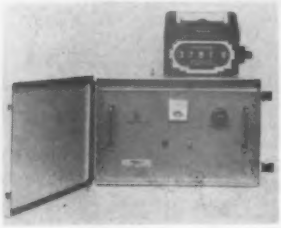


LPG flow volume computer

Recently introduced is this LPG flow measurement system that corrects volume for variations of gravity and temperature with continuous readout of flow in barrels of LPG. It uses an orifice as the primary flow element and connects to transducers which detect temperature, differential pressure, and specific gravity. Volume reduction is automatically calculated.

The Model 257 LPG computer has more than 99% measurement accuracy and is made of solid-state electronic components. Readout is presented by both visual counter and printed records. Telemetered outputs are also available. Source: **Computers, Inc.,** 5123 Glenmont, Houston 36, Tex.

•

Instrument checks buried coatings

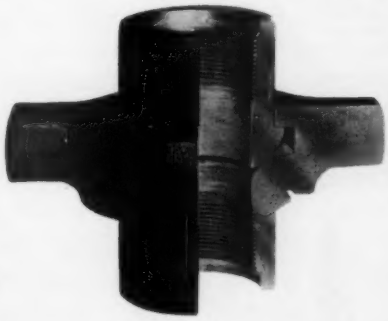
The condition of coatings on buried pipelines can be inspected with a portable electronic instrument which has been developed, called the Class 541 Electronic Coating Inspector, that features a transistorized circuit and, compared to older models, greater sensitivity, portability, and battery life.

Flaws in pipe coatings are indicated and positioned two ways: audibly by a variation in a tone signal received through a headset or visually by an output indicator. With the proper attachments, the instrument can be used to trace buried pipelines. Source: **Nelson**

...it's especially

advantageous for multi-rig owners

You can utilize your equipment to the utmost... save time and money in doing so... when you standardize with WECO Unions. Manifolds, piping, fittings and much equipment can be switched from rig to rig without trouble and without replacing connections, because WECO Unions in the same size and pressure rating are completely interchangeable. They are built to withstand the roughest oil field service... to provide perfect fitting, leakproof connections even after repeated make-up and breakout.



Talk to your WECO representative now about standardizing with WECO Unions. There's a size, type and pressure rating for every rig requirement.

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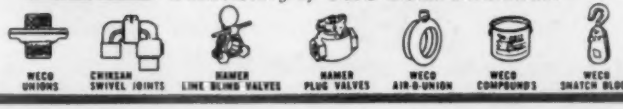

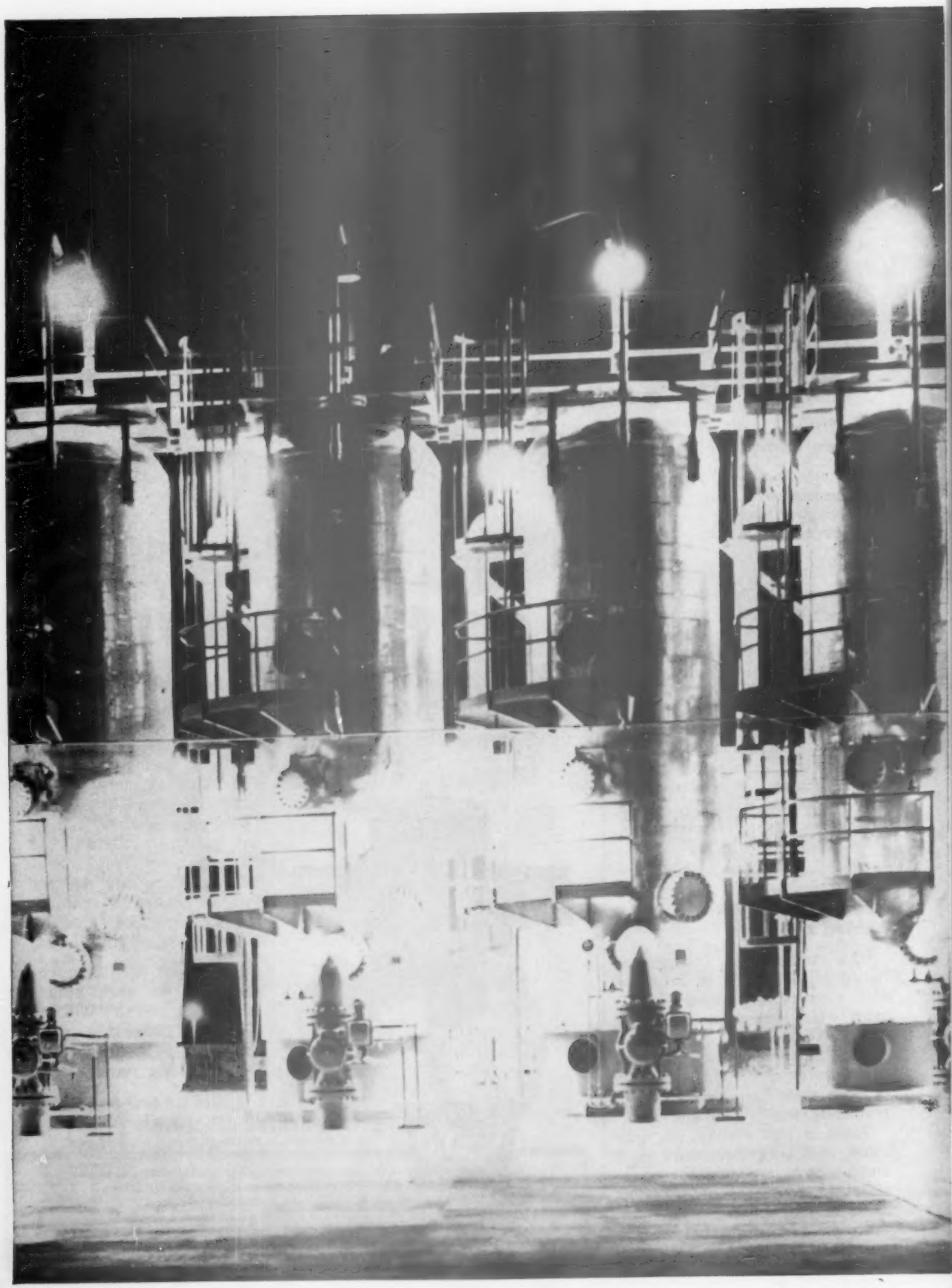

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GAS PROCESSING

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For complete technical assistance on glycol systems for gas dehydration . . . or in controlling a rising dew point *before* it becomes a costly problem—call Dow.

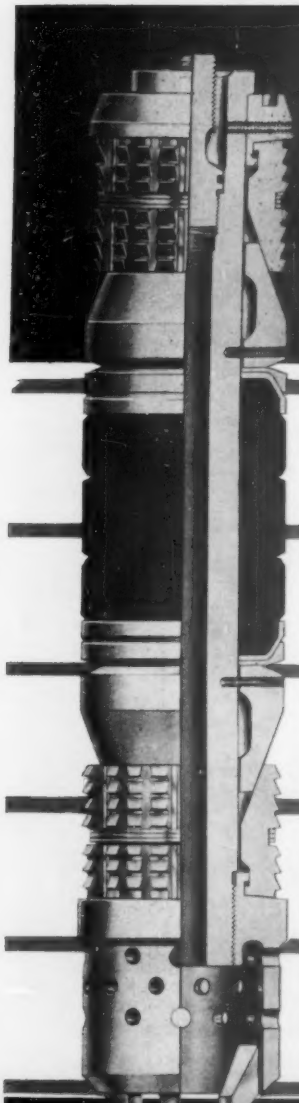
For glycol dehydration troubles such as glycol degradation, corrosion, contamination, and excessive glycol losses, Dow representatives and distributors are available and can quickly obtain the services of technical personnel from Dow's Gas Conditioning Laboratory.

In addition, improvements in gas analysis and processing are constantly being made in the Dow Gas Conditioning Laboratory. Many of these may be useful to you in your own laboratory. One example: a simple, fast, accurate gas chromatographic technique that analyzes natural gas for troublesome components. Details on equipment and method are available on request.

Fast, efficient delivery of glycols for hydrate inhibition and dehydration as well as amines for sweetening, is assured by Dow's network of production plants, terminal facilities, and their distributor warehouses.

For Gas Conditioning problems of dehydrating, sweetening or hydrate inhibition, consult Dow. Call your nearest Dow sales office, or contact Dow in Midland, Michigan.

THE DOW CHEMICAL COMPANY DOW Midland, Michigan



TYPE BC OTIS WIRE LINE BRIDGE PLUG

1 SHORT, COMPACT — LESS TO DRILL UP

2 SMALL O.D. FOR EASE OF RUNNING

3 AVAILABLE IN A FULL RANGE OF CASING SIZES

4 COVERS A WIDER RANGE OF CASING WEIGHTS

5 CAN BE SET WITH ANY PRESSURE SETTING TOOL

Every time you specify the Type BC Otis Wire Line Bridge Plug, you get 5 plus features designed to help you take the guesswork out of your plugging operations—and yet the plug costs you no more than an ordinary plug. For this reason, many operators have standardized on the Type BC. They found they could successfully run the Type BC where other plugs failed to get down. In addition to the 5 big advantages you get with a Type BC Bridge Plug, you will find it's available from leading electric line service companies and stocked in over 200 different field locations — wherever you need it. Take the guesswork out of your plugging operations — the next time you need a bridge plug, specify Otis.

Type BC Otis Wire Line Bridge Plugs are available in these sizes:

SIZES	CASING WEIGHTS	SIZES	CASING WEIGHTS
2⅞"	6.4 – 8.6 lb.	5½"	13 – 20 Lb.
4½"	11.6 – 15.1 Lb.	6⅝"	17 – 24 Lb.
4½"	9.5 Lb.	7"	20 – 38 Lb.
5"	18.0 Lb.	9⅝"	43.5 – 53.5 Lb.

OTIS ENGINEERING CORPORATION

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Electric Mfg. Co., P. O. Box 5385, Tulsa 16, Okla.

•

New gas-density cell

The type 35 gas-density cell, an instrument designed to provide continuous precise measurement of gas density in pounds - per - cubic - foot, has just been introduced. The instrument produces a differential pressure directly proportional to density. This measurement, combined with a pressure differential across a primary device, makes it possible to determine mass flow of gas.

The gas - density cell measures densities up to 7.8 lb. per cu. ft. It weighs 48 lb. and is 9½ in. in diameter at the flange, and 15-in. high. Both vertical and horizontal mountings are available. Source: **Foxboro Co.,** 86 Neponset St., Foxboro, Mass.

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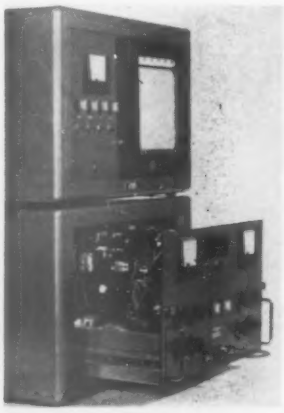

Monitor for gas in drilling mud

Hydrocarbon gases extracted from drilling-mud streams can be detected with a new monitor which

uses an internal-combustion cell assembly and filament to detect the gases. The cell serves to detect and measure the relative amount of hydrocarbon gases present.

Design features include an integrated dual-circuit design, modular case design, and a zero controller. Recorder-chart speed and pen travel can be adjusted to obtain the best recording of data transmitted from the combustion cell.

The Dual TG monitor, designed to operate independently of attending personnel, comes complete with mud-gas sampler, connecting cables, audio alarm, and other essential components. When it is necessary to change from one system to another, only a simple routine is required which can be carried out in a few seconds. Source: **Instrumatic Controls, Inc.,** P. O. Box 7163, Shreveport, La.

●

Chemical-electric emulsion treater

This new chemical-electric crude-oil emulsion treater is designed to minimize fuel requirements. The Chemelectric treater is claimed to be simple to install, to provide automatic operation at minimum treating temperature, to provide a vaportight pressure vessel with built-in low-pressure degassing section, to provide low utility cost and to have chemical requirements no more than for conventional treating. Source: **Petrolite Ltd.,** Heathcoat House, 20 Savile Row, London W.1, England.

●

Explosive gas detector

An indication of the concentration of explosive gas can be obtained with a new detector which has been brought out that indicates the percentage below the explosive concentration of such flammable material as natural gas, gasoline fumes, and others. It can be calibrated for any flammable gas, the maker says.

The instrument is housed in a leather case. The instrument panel controls the operation and contains spare detector elements for use in the event the element in the probe becomes inoperative. Source: **Beard Instruments, Inc.,** 3963 Kirby Dr., Houston, Tex.

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Bit's best friend. Mud that gives low water loss and preserves the bite of a bit—that's just the kind of mud Carbose MX helps produce. Reason: It's a specially modified form of CMC... a Wyandotte Key Chemical that improves sealing properties. It is, in fact, made for mud and only for mud. Try it in yours!
WYANDOTTE CHEMICALS
MICHIGAN ALKALI DIVISION, WYANDOTTE, MICHIGAN

TRADE LITERATURE

Sucker-rod comparison chart

This free chart compares the maker's rods with rods of seven other sucker-rod manufacturers under two main headings—chemical analysis and mechanical properties. Rods are broken down as to name of manufacturer, grade of rod, and type of steel used in the rod. The chart is complete with information on proper handling, installation, application, and selection of sucker rods. Included is a brief description of various types of rods, and a chart on maximum recommended loads. Source: **Continental - Emsco Co.,** Box 359, Dallas 21, Tex.

Method for removing acid gas

This new technical report describes an economical way to remove acid gas by the hot potassium carbonate process. The 30-page report, along with graphs and diagrams, reveals advantages to be gained from this scrubbing process—first developed by the U. S. Bureau of Mines. According to the report, the process is best suited for treating gases above 200-psi. total pressure, with acid-gas partial pressure from 20 to 100 psi. Source: **Solvay Process Div., Allied Chemical Corp.,** 61 Broadway, New York 6, N. Y.

Refinery desalting processes

This new 16-page brochure highlights desalting processes and equipment for petroleum refiners. Supplemented with photographs, photomicrographs, charts, graphs, and drawings, the publication describes processes and equipment of Petreco electric desalting and Tret-O-Lite chemical desalting. Source: **Petreco Div., Petrolite Corp.,** 3202 S. Wayside, Houston 1, Tex.

Cooling-water-system pretreatment

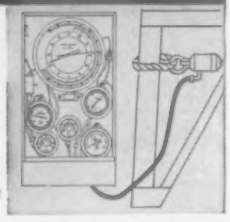
Technical data file C4 features Nalprep pretreatment for preparing and protecting new or freshly cleaned metal surfaces in cooling-water systems. One process bulletin tells when, where, and how to use the pretreatment. Another deals with specific Nalprep products. Included in lab data and case histories. Source: **Nalco Chemical Co.,** 6200 W. 66th Pl., Chicago 38, Ill.

Process instruments

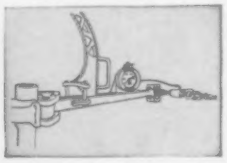
Condensed catalog G-1a is packed with 48 pages of information on instruments and systems for measuring, recording, and controlling industrial processes. Illustrated and described are ElectroniK instruments, ElectriK and pneumatic Tel-O-Set lines, millivoltmeters, primary sensors, filled-system thermometers, pressure gages and transmitters, flow and liquid-level meters, Dur-O-Pulse telemetering systems, special-purpose instruments, computers and data-handling systems, basic industrial controls, and control valves. A typical product page includes an illustration, description with primary specifications, price range, and literature reference. Source: **Industrial Div., Minneapolis-Honeywell Regulator Co.,** Wayne and Windrim Avenues, Philadelphia 44, Pa.

TONG TORQUE

THE MARTIN-DECKER TONG TORQUE ASSEMBLY FOR ALL CONNECTIONS



PERMANENT INSTALLATION
The cylinder attached to the back-up line provides torque indication each time collars are run.



PORTABLE INSTALLATION
The torque assembly attached to the tong itself can be used for spot checks on two or more rigs.

ONE GAUGE for torque measurements of all size drill collars, drill pipe, tubing and casing.

ACCURATE AND RELIABLE readings with calibration checks seldom required.

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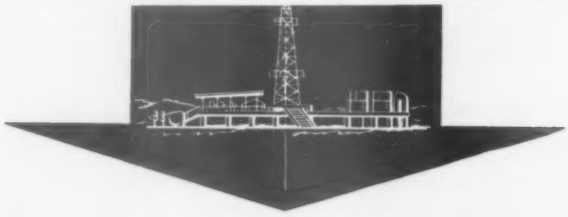

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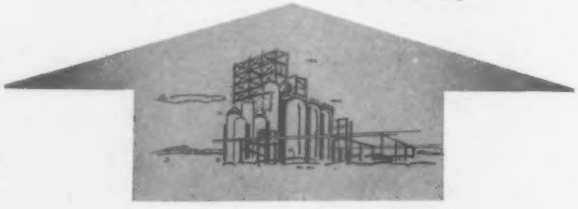
ROBERT F. CASHEN *Assistant Vice President and Manager*



EQUIPMENT MEN

Arthur Connell elected director of Stone & Webster Engineering

A. J. Connell

The announcement was made by President F. W. Argue. Connell joined Stone & Webster in 1951 and became a vice president in 1956. He was a vice president and director of E. B. Badger & Sons Co., of Boston, when that firm was merged with Stone & Webster 10 years ago.

Jones & Laughlin Supply Div. makes six field sales changes

Jones & Laughlin Supply Division has reassigned four members of its field sales force and appointed two new salesmen, according to Bill Wood, general manager of sales.

Don T. Henderson, salesman at Monroe, La., has been transferred to Laurel, Miss.; W. P. Bratcher, salesman at Denver, is now assigned to Hobbs, N. M.; S. M. Dippel, salesman at Victoria, has been moved to Denver; K. M. Snipes, salesman at Kermit, Tex., has been transferred to Rock Springs, Wyo.; Bill A. Leonard, storeman at Seminole, Okla., has been promoted to salesman and assigned to Kermit; and R. E. Hearring, storeman at Carmi, Ill., has been advanced to salesman and moved to Clay City, Ill.

W. C. Norris assigns Chapman

Kenneth Chapman, former field delivery man and warehouse worker for W. C. Norris Division of Dover Corp. at Salem, Ill., has been promoted to sales representative. He has been assigned to the company's Tri-State division and will continue to be headquartered in Salem. Chapman will service accounts in Illinois, Indiana, and Kentucky, under the direction of Earl Carpenter, Tri-State division manager. Chapman has been employed by W. C. Norris in Salem the past 11 years.

FINAL NEGOTIATIONS for the acquisition by Hughes Tool Co. of Herb J. Hawthorne, Inc., are carried out by M. E. Montrose, senior vice president and general manager of Hughes (left), and Herb J. Hawthorne, founder of Herb J. Hawthorne, Inc. Hawthorne manufactures replaceable-blade-type bits for seismic shot hole, exploratory, slim hole, and water-well drilling. Resulting from the purchase was the formation of a wholly owned subsidiary, Hughes-Hawthorne, Inc., to manufacture, sell, and service the Hawthorne bits.

Smith Tool Co. appoints two

Appointment of E. A. Kunnemann as chief engineer—sales and Jim Sayers as manager of West

E. A. Kunnemann

Jim Sayers

Coast, Canadian, and Alaskan sales for Smith Tool Co., a division of Smith Industries International, Inc., has been announced by Kenneth H. Swart, president of Smith Tool. Both men will make headquarters at the company's head office in Compton, Calif.

Kunnemann joined the company in 1958 as Mid-Continent sales engineer. Before that he was with Security Engineering Division of Dresser Industries in an engineering capacity at both the Dallas and Manchester, England operations.

Sayers joined the company 3 years ago. He was named manager of Canadian operations, a position he held for 2 years. In 1960 he was elevated to foreign sales manager. Before joining Smith Tool, Sayers was regional sales manager of the Rocky Mountain and Canadian division for Security Engineering.

General Electric appoints Ellis to newly created field sales post

I. M. Ellis has been named to the newly created position of field sales manager in General Electric's national 2-way-radio headquarters, Lynchburg, Va. Ellis previously was West Coast regional manager for G-E mobile communication equipment with offices at Redwood City, Calif., where he simultaneously served as manager of the G-E Communication Products Department West Coast warehouse assembly plant.

In appointing Ellis, Kent J. Worthen national sales manager for G-E mobile communication equipment, said Ellis would be responsible for coordination of G-E regional and district activities involving all field 2-way-radio salesmen through-

out the nation. Ellis joined the company in 1941 and has been at Redwood City since 1953.

Motorola promotes Bill Shurtleff

Wilford (Bill) Shurtleff has been promoted to microwave sales manager in the Midwest by Motorola Communications & Electronics, Inc. With headquarters in Chicago, Shurtleff will supervise the sale of microwave - radio - relay systems. A 10-year company veteran, he formerly served as microwave district representative in the Midwest, and as a microwave field and systems engineer.

Motorola also named Walter P. Herbold as microwave industrial communications representative in the Midwest, with offices in Chicago. Herbold, who joined Motorola in 1955, previously served as microwave systems engineer.

Onan appoints zone sales mgr.

Appointment of George Ullrich, Jr., formerly with Harrison Equipment Co., Onan distributor in Houston, to zone sales manager for Onan Division of Studebaker - Packard Corp., has been announced by Roy Mullin, vice president of marketing. Ullrich will assume responsibilities for sales of all Onan products in a territory covering most of Texas and Mississippi and all of Louisiana.

Consulting firm set up in Houston

Thomas Instrumentation & Research Co. has been established in Houston by Dr. Ben W. Thomas for the purpose of offering consultation, research, and service in process control through analysis instrumentation. In this endeavor, Dr. Thomas plans to work with refining and petrochemical manufacturing companies toward improved performance of their process operations.

Prior to establishing TIRCO, Dr. Thomas was employed by Texas Butadiene & Chemical Corp. as director of instrumentation physics research. Earlier he had worked for Humble Oil & Refining Co. as senior research specialist.

Second-recovery-equipment department formed by Bovaird

F. C. Underwood

Establishment of a special secondary - recovery-equipment department by Bovaird Supply Co., of Tulsa, under the direction of F. Clay Underwood as sales manager, has been announced by R. E. Batchelor, Bovaird vice president. Underwood was with Bethlehem Supply Division for 11 years, the last several of which he headed secondary - recovery - equipment sales.

Fire Control Engineering Co. appoints sales representative

LeRoy E. Burner has been named sales representative for Fire Control Engineering Co., of Fort Worth. His offices will be at 515 Texas National Bank Building in Houston. The announcement was made by Arch H. Rowan, Jr., president of Fire Control. Burner was with National Supply in Fort Worth for 15

PROBLEM: STOP CASING LEAKS IN 122 OIL WELLS

There was an increasing number of casing leaks in 122 oil wells in this field in Northern Wyoming. Something had to be done to stop external corrosion.

CSI engineers were called to install a cathodic protection system for each well. They determined the amount of electrical current required for protection, using the "log current potential method" patented by a CSI engineer. Then they installed graphite anodes and rectifiers. 20-foot holes were augered for the ground beds.

CSI provided a turnkey job—furnishing all labor, equipment, materials and a written report. CSI also instructed the oil company's personnel in proper operating procedures.

Many operators are learning to rely on CSI for the best in engineering and installation services, and for quality supplies for both magnesium anode and rectifier installations—on wells, pipelines, tanks, etc. Prices are competitive. Call or write for estimates or quotations.

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111 PETROLEUM ENGINEERING: DRILLING AND WELL COMPLETIONS by Carl Gatlin—Covers all factors involved in successful drilling, testing, evaluating and completion of an oil well. The first book to employ an integrated approach to petroleum engineering, that is to connect the drilling phase to reservoir engineering concepts. (1960), 288 pages, 8½ x 11. . **$13.00**

101 ACCOUNTING FOR OIL AND GAS PRODUCERS by Smith and Brock—Presents in detail the accounting principles and actual accounting practices being followed by oil and gas producers. 544 pages . . . **$10.65**

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119 SUCCESSFUL PROCESS PLANT PRACTICES by Robert Davidson—A how-to-do-it manual of process plant problems and how they have been solved in actual practice. Covers managing, scheduling, operating, maintaining, and repairing. (1958), 302 pages, 276 illustrations. **$10.00**

89 PRACTICAL OIL GEOLOGY by Hager—Clear, concise, practical . . . methods for searching untested areas . . . selection of sites . . . application of geology in drilling . . . section on Vearch's rule (1951), 589 pages. **$9.00**

104 HANDBOOK OF NATURAL GAS ENGINEERING by D. L. Katz, et al—Provides the information required by an engineer practicing in the natural gas industry. Form design calculations and quantitative charts for determining equipment needed or methods required for handling natural gas. Full treatment-from occurance to marketing of natural gas. (1959), 802 pages, 8½ x 11, 887 illustrations. **$37.50**

78 OIL WELL DRILLING TECHNOLOGY by McCray and Cole—A discussion of the geological and geophysical principles governing oil accumulation and drilling of wells . . . methods of discovery . . . types of drilling and drilling tools . . . cementing operations . . . costs and ways of paying drilling charges (1959), 492 pages. **$9.95**

114 PETROLEUM RESERVOIR ENGINEERING by Amyz, Bass and Whiting—Develops the fundamental concepts of rock and fluid properties on which reservoir engineering is based. Covers measurement and analysis of rock properties and or fluid properties. Organization of data for use in volumetric and material balance equations for determination of the value of oil in place. (1960), 610 pages. **$17.50**

79 APPLIED PETROLEUM RESERVOIR ENGINEERING by Craft and Hawkins—A practical guide that applies petroleum engineering data to the calculation of reservoir performance under a variety of production methods. The secondary recovery of additional oil from abandoned or depleted fields is explained as one of the applications of reservoir engineering (1959). **$12.00**

105 THE NATURAL GAS INDUSTRY by Edward J. Neuner—Here is a detailed, impartial investigation of the most controversial public economic policy of our time. A factual and analytical foundation upon which a rational decision can be made. For all who are concerned with the details of natural gas production and its regulation, control, and resulting price to customers. (1960). **$5.75**

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years and later was machinery sales manager for Iverson Supply Co., in Tulsa.

Dow Industrial Service appoints William T. Brooks, L. B. Wilson

Dow Industrial Service, Cleveland, a division of Dow Chemical Co., has named William T. Brooks and L. B. Wilson as account managers in regional offices. Brooks has been assigned to the Midwest region with headquarters in Chicago. Wilson will be located in the company's eastern region directed from New York City.

Dow Industrial Service maintains nation-wide facilities for chemical cleaning of high-pressure boilers and industrial process equipment.

Robert J. Mullenbach becomes E-M vice president and director

Mullenbach's promotion was announced at the recent annual meeting of Electric Machinery Mfg. Co., in Minneapolis. He joined Electric Machinery last April as general manager of the Control Division, moving from E-M's Mullenbach Division in Los Angeles. Mullenbach will also continue as general manager of the Control Division.

Ray C. Loudenback joins Rodman Supply Co.

Loudenback will serve as district sales representative with headquarters in Dallas. A veteran of 25 years in the oil fields, he represented another supply firm in Dallas the past 5 years. Earlier he was associated with a machinery manufacturer.

National Supply Division names pair to store-manager positions

Arthur G. Carlin has been appointed store manager at Opelousas, La., and Herbert D. Houston at McAllen, Tex., by National Supply Division of Armco Steel Corp. Carlin started at the Opelousas store in 1956. He also has had experience as a field salesman there and in Houma and New Iberia, La. Houston began at the McAllen store in 1956.

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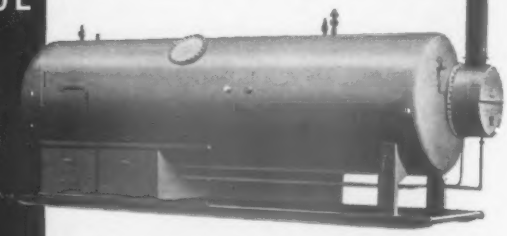
ALL-PURPOSE ECONOMY for Toughest Treating Problems!

Oil Emulsion Treater



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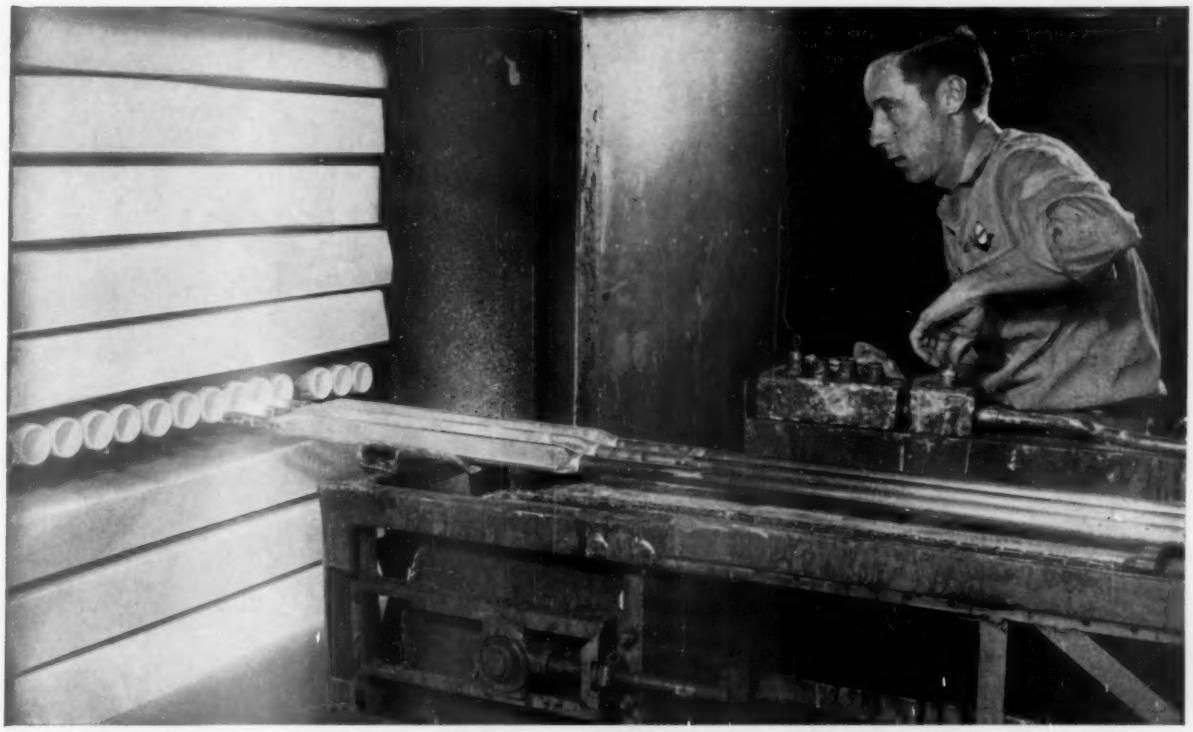

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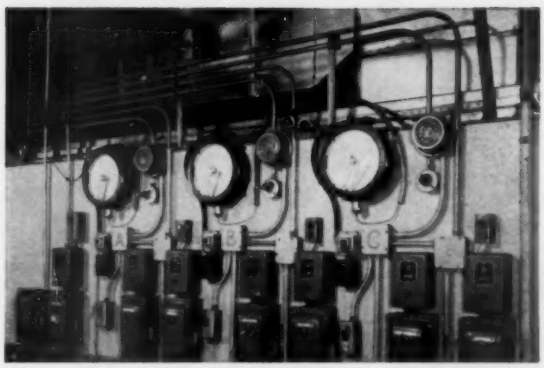
At Plastic Applicators, we apply Plasticap coatings only to carefully sandblasted, metal-clean pipe surfaces, using the unique application equipment shown above. Plastic Applicators engineers designed these efficient spraying lances to apply consistently uniform plastic coatings to pipe placed in baking ovens. To prevent moving the pipe before each successive coating has been applied and baked, our engineers designed a special conveyor mechanism to move the lances from oven to oven.

Another part of the answer to effective quality control at the four Plastic Applicators plants is in the process-control equipment shown below. The optimum time and temperature for each baking cycle are precisely programmed by these control devices to produce exactly the same result each time an ovenload of coated pipe is baked.

You can put these important quality-control procedures to work for you by specifying long-lasting



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BETTER COATINGS THROUGH RESEARCH

PLASTIC APPLICATORS, INC.

OUR
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Season's
Greetings
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DETROIT-AREA motorists will get a close look at where their home and car fuels come from. Scene of current exploratory drilling campaign is along the right-of-way of Edward Hines Parkway just west of Detroit.

Parkway drilling sets pace for Southeast Michigan

A SUCCESSFUL exploratory effort is going on in Wayne County, Michigan, near Plymouth. Peake Petroleum Co., of Cleveland, is drilling its third test along the Edward Hines Parkway, and the fifth test of the program.

According to recent reports, a typical well in the area will make 2.5 million cubic feet of gas and 45 bbl. of oil daily. The well in the photo above is expected to reach the pay formation at 4,300 ft.

The land was leased to the operator by the Wayne County Road Commission. Drilling activity in Wayne County is relatively new. Other production in the state is considerably to the northwest in Allegan County which is in the west-central portion of the state.

Contractor for Peake Petroleum is Hilliard Drilling Co., of Mount Pleasant, Mich. The rig is a portable Franks 4500 with a 96-ft. derrick. Other equipment includes a 214B Oilwell pump and two NHS 290 Cummins diesels which provide all power requirements through an Alamo compound gear box.

If production is found, 5½-in. oil string will be run. Production also occurs to the north in the "thumb area" of the Southern Peninsula.

Drilling-rig use shows increase

ACCORDING to AAODC drilling figures, the second half of the year (to December 1) showed an increase over the first half for total rigs working. The figures for rotary and cable-tool rigs includes all units tearing down or rigging up, drilling, cementing, completing, fishing or temporarily shut down. Not included are cable-tool units completing rotary-drilled holes.

During the first half, the average number of rigs working during the 26-week period were: rotary, 2,044; cable tools, 582; and total, 2,626. The highs for each category from January through June were: 2,240 rotaries on June 16; 680 standard tools on June 30; and total rigs 2,885 on June 16. The lows recorded were: 1,894 rotaries on January 20; 530 cable tools on March 31; and 2,424 total rigs on March 31.

The second-half averages through the first 22 weeks to December 1 were: 2,070 rotaries; 605 standard-tool units; and 2,675 total rigs. Second-half highs were: 2,287 rotaries on August 11; 680 cable-tool rigs on July 7; and 2,894 total rigs on August 11. The lows from July through December 1 were: 1,692 rotaries on November 24; 552 cable tools on August 4; and 2,268 in both categories on November 24.

Christmas Trees from REPUBLIC SUPPLY!

True, they are not the kind on which children hang tinsel and brightly colored ornaments.

They are, however, quality, rugged trees of steel made by leading manufacturers in this field. REPUBLIC SUPPLY has them available, not just in December, but the year 'round—as we have for the past 51 years!

Like the "Christmas Trees," REPUBLIC SUPPLY and all the other quality products we represent stand as a symbol of the free world, free enterprise and a Christian nation which pauses during this joyous season to count our many blessings.

May yours be bountiful!

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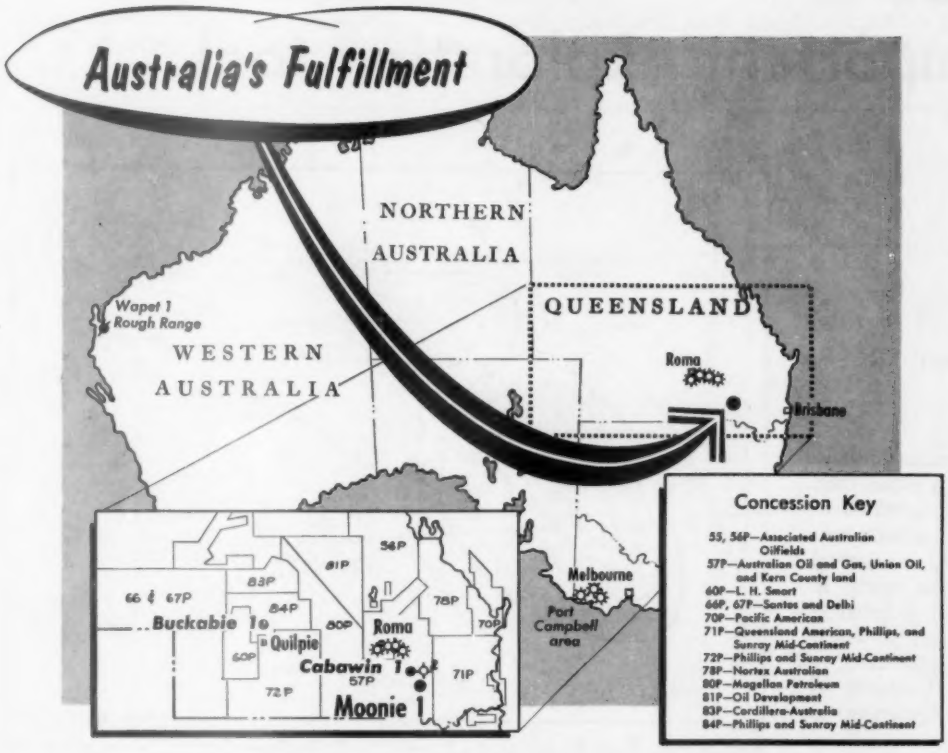


OIL has now been found on the west coast, and near the east coast of Australia. Gas fields on the southeastern coast and at Roma, and oil flows in Papua indicate that the entire continent down under is an oil target. Continued persistence and government cooperation will probably bring it into major production within 3 to 5 years. Latest discovery, arrowed here, is the Union Oil Co. 1 Moonie, indicated 250-bbl. oiler.

The waiting is over down under

by FRANK J. GARDNER

IF YOU HAD drilled 500 wells, spent $142 million, and uncovered only a couple of noncommercial oil wells and half a dozen borderline gassers, would you give up the search?

Australians didn't. In fact, in the last 3 years, a combination of government subsidy, industry determination, and plain persistence has produced the most aggressive deep-drilling campaigns in that country's history.

And now. the effort pays off . . maybe. Union Oil Co. of California isn't yet sure just what it has uncorked at its 1 Moonie, but first tests indicate that at long last, Australia has its first real oil field (OGJ, Dec. 11, 1961, p. 63).

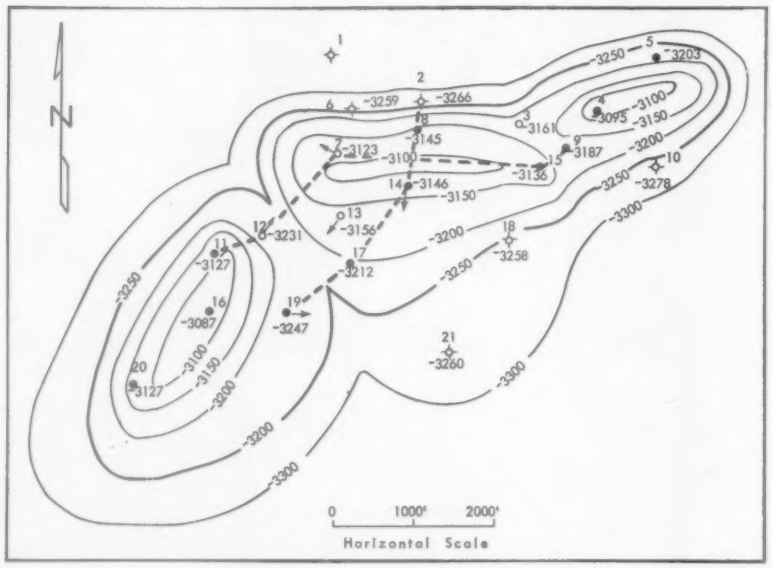
Lying in southeastern Queensland in the Surat embayment of the Great Artesian basin, this discovery well could easily be the key to a new industrial future for Australia. And there is every indication that it is a success. Union ran a drill-stem test opposite Bundamba-Triassic sandstone at 5,816-5,925 ft.; the flow, 250 bbl. per day of 48°-gravity oil, 400 M.c.f. gas, and 250 bbl. of water, was one of the most encouraging ever recorded in the country. Operator has now bottomed the well at 6,106 ft. and will run 5½-in. casing and make additional production tests. The well had a show higher up the hole at 5,640-90 ft., in the same Bundamba formation, but this was not tested; log of the well indicated possibilities, however, at the upper level. Before final completion is attempted, Union will test both zones.

The 1 Moonie lies 200 miles west of Brisbane, and is the third Australian wildcat to be drilled by Union and its partners, Kern County Land Co. and Australian Oil & Gas Corp., Ltd. The first, 1 Cabawin, 18 miles northwest of the 1 Moonie, went to 12,035 ft. and caused great excitement last May, after a series of tests averaging 62 to 85 bbl. daily, but the 1 Cabawin settled to 60 bbl. per day and has been shut in. Production came from an 8-ft. Permian sand zone at 9,928 ft. The partnership's second wildcat, 1 Cabawin East, was abandoned last month at 12,091 ft.; it was 4 miles east of the 1 Cabawin, across a fault. The sands found in the first well were much deeper and had shaled out in the East well.

Union will now take time for reappraisal—of the well, the formations, and the structure. The company feels that some additional seismic work may be necessary to feel out the true subsurface picture. Both potential pay zones will be evaluated, and a series of flow tests run. Commercial or not, the 1 Moonie definitely stamps Australia as oil country. The flows at Cabawin and Moonie, plus the erratic discovery clear across the continent at Rough Range in 1953, throw the entire nation into the "prospective" column.

Continuous dipmeter survey can be an important exploration tool

Here's how reef-type structures were found in West Central Texas.



HERE is the structure map of the Powers field, Stephens County, Texas, contoured on the top of the Mississippian. Lines of section for Figs. 2 and 3 are shown. Fig. 1.

BY J. D. THOMPSON
Schlumberger Well Surveying Corp.
Fort Worth

ANALYSIS of formation dips in overlying formations has established a method of locating the position of reefs by continuous dipmeter surveys. While experience is limited largely to Mississippian reefs of North Central Texas, it is believed that the characteristic dips on which the method depends may hold in general for reef-type structures so that application may be extended to other areas.

Beds overlying reefs exhibit dip patterns similar to the draping effect encountered in beds overlying bar deposits. Decreasing of dips upward through successive overlying beds is characteristic. Dips recorded within the reefs themselves are generally of little value to the interpretation due to absence of bedding.

Reef-dip relationships. It has been found that dips at the reef contact decrease in the direction of the crest at a nearly constant rate. A simple projection, based on the dips shown by the dipmeter survey in a single well, may thus indicate the location of the top of the reef. The position is confirmed or corrected, as data from succeeding wells are added. The reefs on which this study was made have a gently sloping side, or backreef, with lower dips as compared to the steeper side, or forereef. Dips on the backreef range from 2° to 3° on top, to a maximum of 22° on the flanks, while dips on the forereef range from 3° or 4° near the top, to a maximum of 32° on the flanks. In Stephens and Young counties, the rate of decrease in dip as the crest is approached has been found to be 1° for each 25 ft. of horizontal displacement over the backreef, and 1° for each 10 ft. of horizontal displacement over the forereef.

Study of the dipmeter logs, induction-electrical logs, sonic logs, micrologs, and core examinations show that the reefs are generally in the same position today as when they were formed. There is little evidence of reworked material that might confuse the interpretation.

Correlating the dips obtained in the dipmeter survey with core description and analysis adds additional basis for locating the well with respect to the reef structure. Fine-grain material with porosity of 8 to 12% is associated with the backreef. Coarser grain material with porosity of 12 to 15% is associated with the steeper flanked forereef. Together, core information and the dips encountered indicate whether the initial well is on the back or forereef.

A good record with reefs. The odds on success in this application of the dipmeter to reef location are regarded so highly by some operators that they have reopened a number of dry holes solely to obtain dipmeter logs. These holes, drilled several years ago on geophysical highs, encountered shows but no

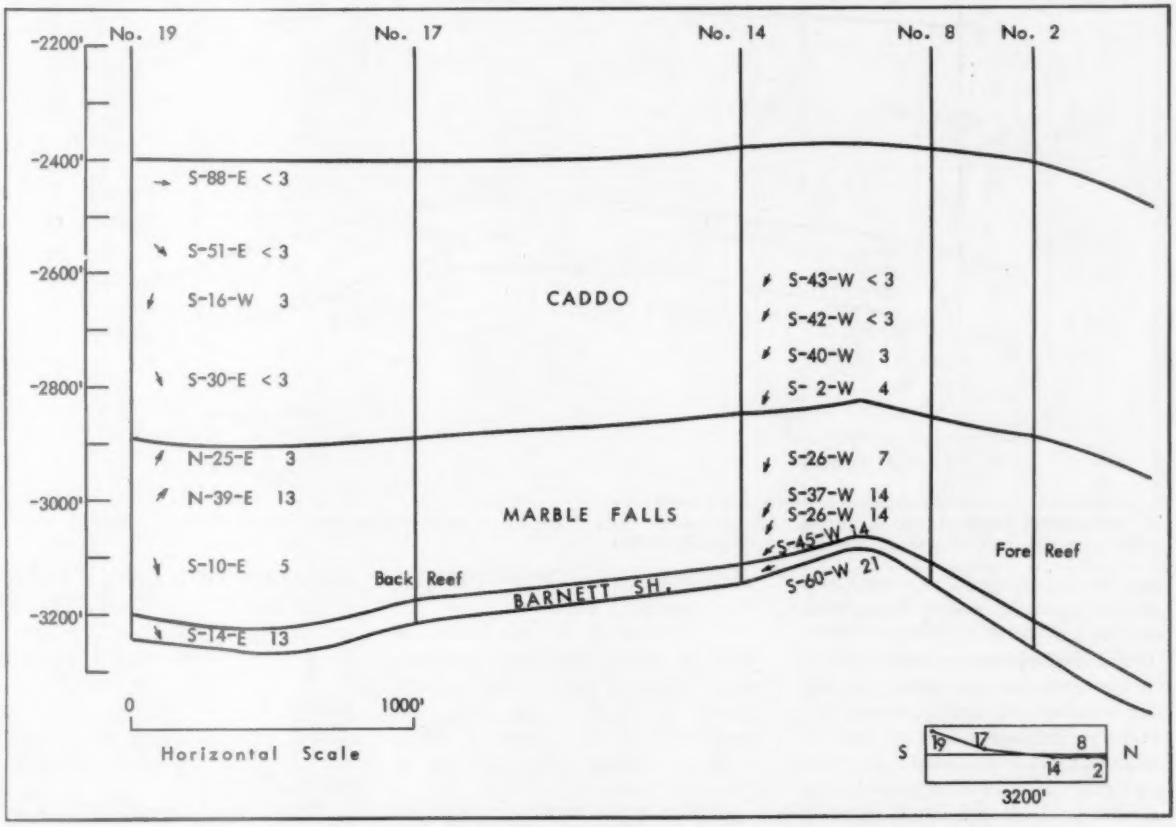
ABOUT THE AUTHOR—

J. D. Thompson joined the field organization of Schlumberger Well Surveying Corp. at Graham, Tex., in 1948. In 1953 he moved to Fort Worth where he has been area staff specialist handling the computation and interpretation of dipmeter surveys.

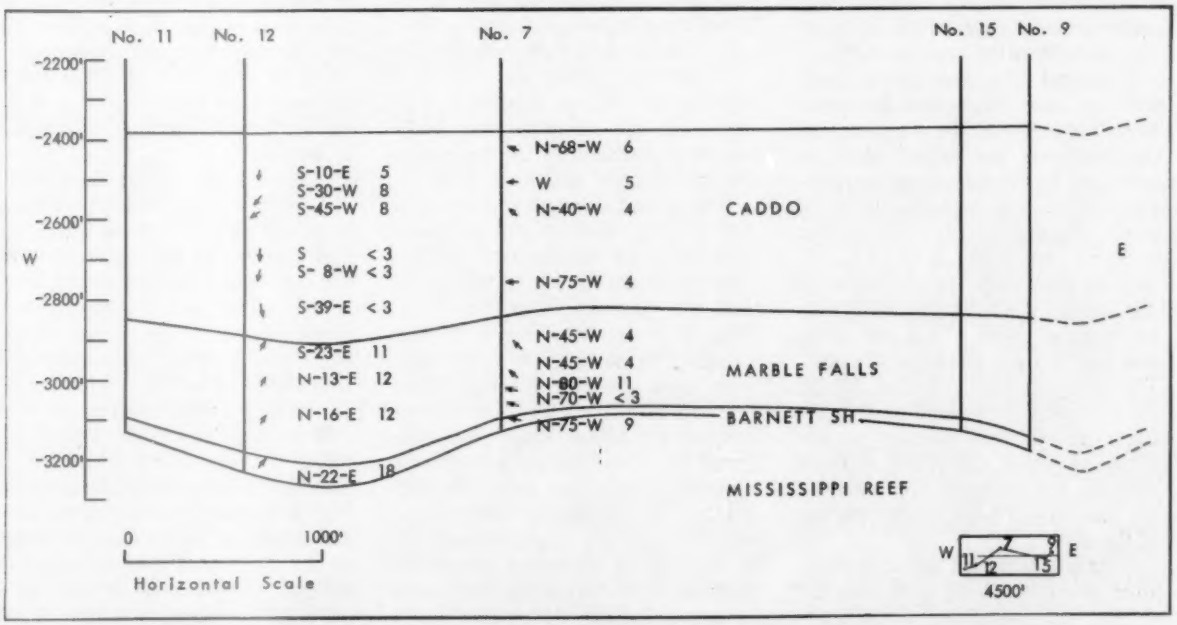
Thompson is a graduate of Texas Christian University, where his major studies were in the fields of physics, mathematics, and geology.

commercial production. Dip surveys in several of these dry holes showed that they were located off the actual tops of the structures. As a result of the dipmeter logs, two wells drilled 500 ft. or less updip from dry holes have gained as much as 150 ft. of structure and have established discovery production.

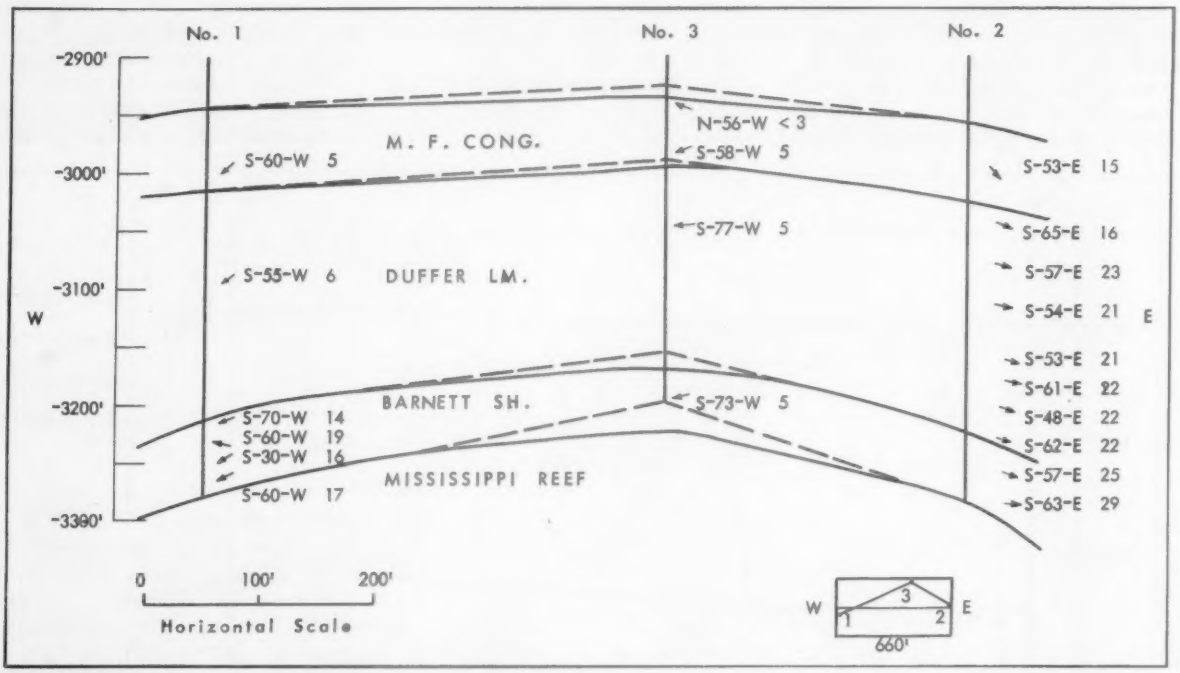
The fields considered here are bioherm reef-type structures. Bioherms in the Mississippian formation are located within a 30-mile strip covering parts of Shackleford, Stephens, Throckmorton, Young, and Archer counties in a southwest-northeast trend. Depending on the surface elevation and the position on



IN THIS NORTH-SOUTH CROSS-SECTION, wells 14 and 19 had dipmeter surveys. Fig. 2.



THE EAST-WEST CROSS-SECTION at Powers field used dipmeter data obtained from wells 7 and 12. Fig. 3.



IN MISSISSIPPI FIELD of Young County, Texas, wells 1 and 2 dipmeter surveys provided information for locating well 3. solid lines are predictions; dashed lines are actual values. Fig. 4

the southwest-northeast trend, the Mississippian formation is encountered at a depth of 4,200-5,000 ft.

The first of two examples chosen to illustrate the application of dipmeter surveys to reef location is the Powers Mississippian Reef field of Stephens County, Texas. A structure map (Fig. 1) drawn on the top of the reef, is presented together with east - west and north - south cross-sections (Fig. 2 and 3). Dipmeter surveys were made in 4 of the 10 wells in the cross-sections.

This reef has three highs, each with its own back and forereefs. Note, for instance, the steep dips to the north on the center high, as indicated by the difference in elevation (121 ft.) between wells 2 and 8. The north-south cross-section built on the wells 2, 8, 14, 17, and 19 illustrates the variation in dips across the structure from fore to backreef. Well 1 was off structure and did not penetrate the reef. The dips of wells 12 and 14, in the east-west cross-section and the north - south cross - section respectively, show the magnitude of flank dips on the backreef compared to the low dips of well 7 near the top of the reef.

Note also that dips due to deformation of the overlying beds over the sloping reef had ended in the east-west direction and nearly so in the north-south direction by the time the top of the Caddo was laid.

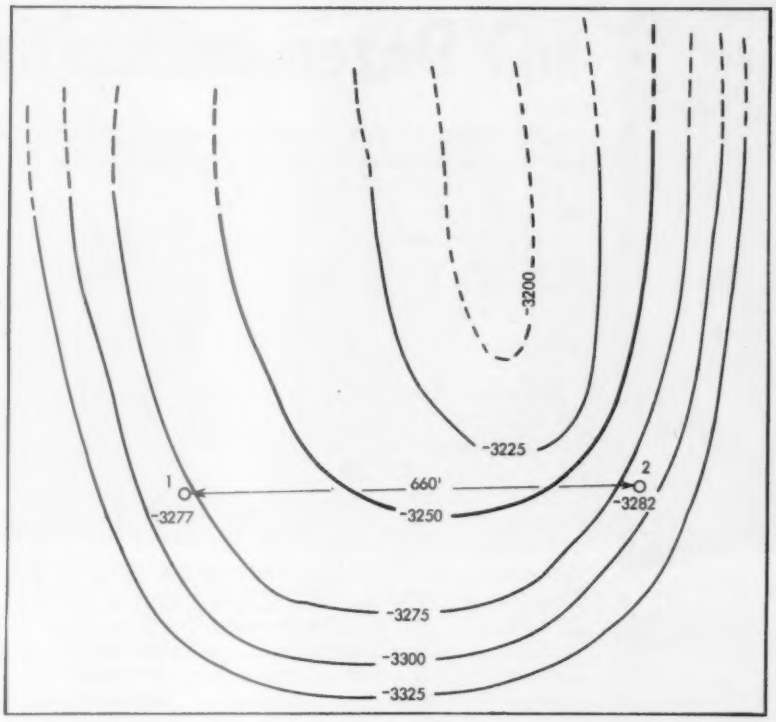
An interesting feature occurs in well 12 on the east-west cross-section. This well shows 180° change in direction of dip and a change in magnitude of dips below −2,820 ft. The explanation is apparent on the structure map. Well 12 is drilled on a low between two highs. The Caddo section is draped off one structural high, while the formations below the Caddo are draped off the other. The dipmeter information was credited with finding the structural high on the left, or southwest. The arrow on the structure map indicates the direction of the formation dip immediately above the reef.

The second example shows how a reef may be located and progressively defined from dip data, starting with the dipmeter log in the initial well. The data covers the first three wells of a reef discovery in Young County, Texas. Fig. 4 is an east-west cross - section through these three wells. Wells 1 and 2 straddling the reef are 660 ft. apart. The dipmeter log in well 1 gave a southwest direction of dips just above the reef contact. By projecting updip from well 1, using the characteristic rate of decrease in dip noted above, the position of the top of the reef could be approximately determined. It could then be reasonably assumed that well 2, 660 ft. to the east would be on the opposite flank. The dipmeter log of well 2, giving dips to the southeast confirmed its position. Note the difference in magnitude of dips at the reef contacts, which, together with formation data, placed well 1 on the backreef and well 2 on the forereef.

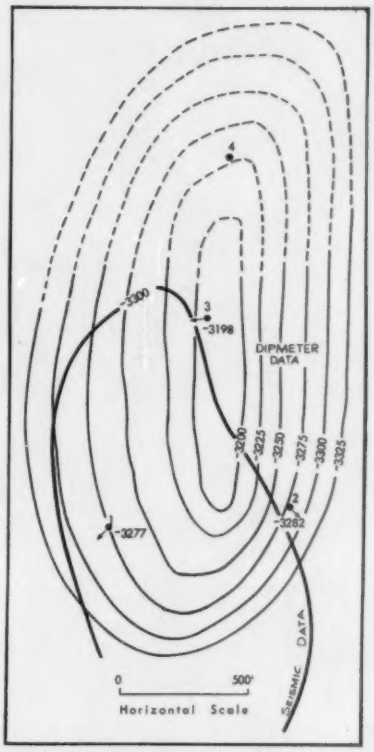
Adding the information from well 2, an east - west cross - section was projected. This is shown by the solid lines of Fig. 4. Also, from the dips in only these two wells, closure could be drawn on the south end of the reef. The beginning of a structure map could be formed as shown in Fig. 5.

After considering this data, well 3 was drilled approximately 900 ft. northeast of well 2 to encounter the reef near its top. The accuracy of the location is confirmed by the low dip at the reef contact. On the east-west cross section of Fig. 4, the dashed lines give actual formation tops established by well 3 as compared to the predicted tops (solid lines).

The dip data from well 3 enabled the development of the structure map to the point shown in Fig. 6. In this extension of the map, the flanks of the reef are projected to the north with only a suggestion of closure. The crest of the reef is accurately placed at within 50 ft. east of well 3.



STRUCTURE MAP on Mississippian from wells 1 and 2 dipmeter data presented this picture. After well 3 was drilled, picture changed as shown in next figure. Fig. 5.



NOTE the differences between seismic and dipmeter data after well 3 was drilled. Seismic was wrong. Fig. 6.

On the basis of dipmeter results, it can be reasonably assumed that a fourth well located approximately 600 ft. to the north and slightly east of well 3 would be a producer.

Finally, the dipmeter survey in this fourth well would further define the direction of the crest of the reef, allow an extension of the contours on the flanks, and perhaps, show where to start the closure on the north end of the structure.

On the map, Fig. 6, the heavy solid line is the 3,300-ft. contour of the same reef structure as drawn from seismic data. The 3,300-ft. contour is the highest given seismic interpretation. As the dipmeter data are developed, it becomes evident that the area of closure may be considerably increased and the position of the high will be changed by several hundred feet from that predicted by the geophysical survey.

Occidental well hits 24 M.M.c.f. during completion test

THE BIG GAS WELL creating a stir in California exploration circles flowed at the rate of 24,350 M.c.f.d. on a completion test of only 88 ft. of the more than 700 ft. of net gas sand in the well.

Occidental Petroleum Corp. reports this high flow on its 1 Lathrop unit B in 5-1s-6e, in San Joaquin County. The test was run on three perforated intervals, 8,354-94 ft., 8,402-23 ft., and 8,560-85 ft., the deepest of the four Upper Cretaceous E zones found in the well. Flow was through the tubing and a 1-in. choke.

Occidental also reports a successful drill-stem test in the first E-zone interval found in the 1 Occidental-Universal Consolidated Oil Co. Unit One, which is 5,700 ft. east of B-1.

The Occidental - Universal well flowed at the rate of 5,270 M.c.f.d. through a ¼-in. choke from 7,523-59 ft. Initial and final flowing pressures were in excess of 3,000 psi. and building up at the end of the 78-minute test.

The operator is drilling ahead in the 1 Unit One toward a target depth of 10,000 ft. The well is in 4-1s-6e.

Occidental plans nine more locations on its 6,000-acre Lathrop lease. In addition to the B-1, the company has completed the discovery well in Section 5.

Plans also call for a twin well near the B-1 in order to produce some of the sands behind the pipe. The 5½-in. casing in the B-1 prevented completion in more than one zone.

Two discoveries. Two other gas finds made in recent weeks in California have been completed.

Occidental completed its 1 Keller estate in 35-2n-1w in Contra Costa County flowing at the rate of 1,030 M.c.f.d. from the Domengine sand at 1,640-45 ft. and 1,735-58 ft. The wildcat is the discovery well in Mulligan Hill field.

A wildcat west of Sacramento in 26-9n-3e in Yolo County has been completed by Phillips Petroleum Co. at the rate of 1,495 M.c.f.d. Phillips took the 1 Swanston to 11,194 ft., but plugged back to 2,167 ft. to pick up the completion in a small section of the Tehama sand.

Dozen tests active

THE BUSIEST OIL PLAY in the San Juan basin is forging ahead at Cha Cha and Totah Gallup Cretaceous oil fields, just southwest of the city of Farmington, northwestern New Mexico. Since the fall of 1959 more than 150 oil wells have been completed in this Gallup sand prize area.

Discovery wells. Benson-Montin-Greer 2 Jones, SW NE 17-28n-13w, San Juan County, opened Cha Cha field in October 1959 for 132 bbl. of oil per day from Gallup perforations at 5,323-76 ft. Totah field was opened in September 1959 at Tenneco Oil Co. 8 Glenn Callow in SW SE 27-29n-13w, flowing 514 bbl. per day from Gallup at 5,195-5,247 ft. Cha Cha is 11 miles long, Totah 8.

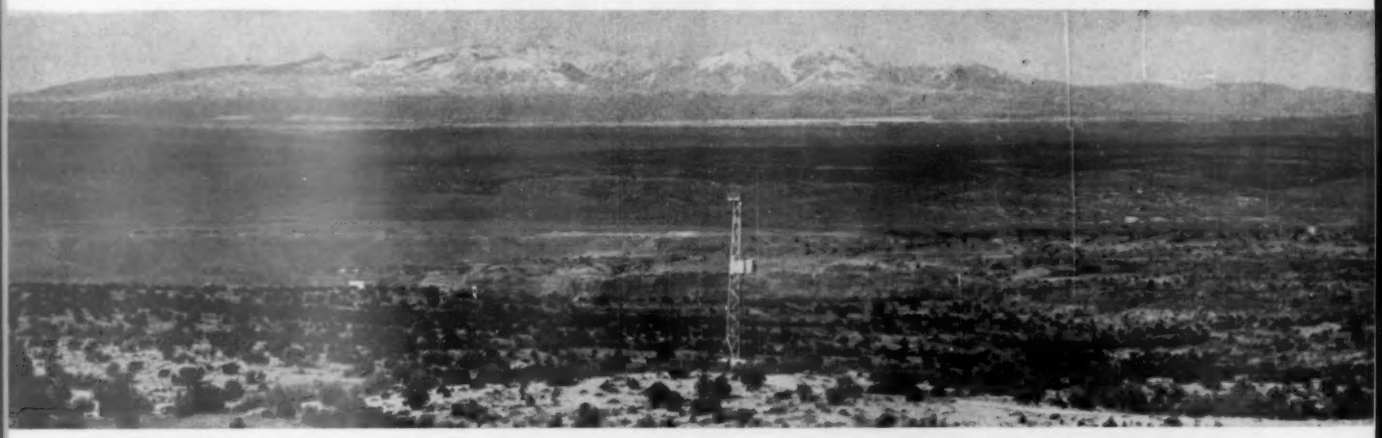
Spacing pattern is 80 acres except for the northwest part of Cha Cha where some wells have 160-acre unit spacing. Proved acreage to September 1961 was 8,320

(Photos courtesy Pan American Petroleum Corp.'s "Horizons.")

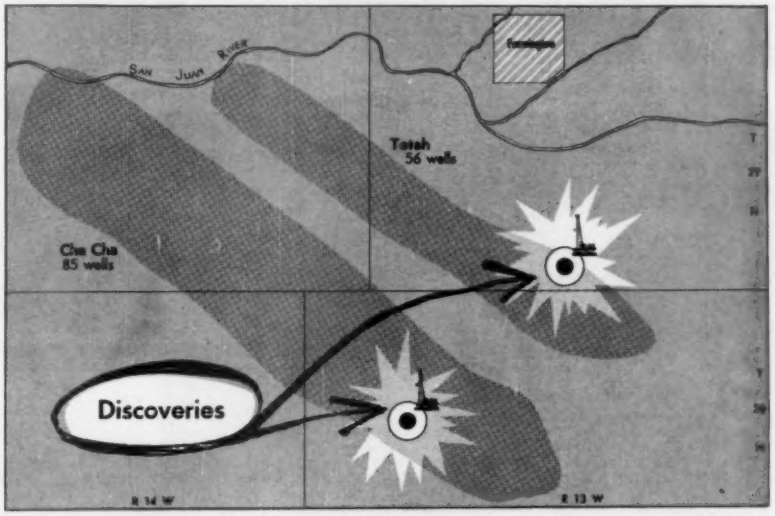
WELL LOCATIONS at Cha Cha and Totah have moved into wild rocky terrain southeastward from the San Juan River and southwest of the city of Farmington.

GEORGE EATON, senior petroleum engineer for Pan American, left, checks plans with contractor for the new gathering line collecting casinghead gas formerly flared.

in San Juan's Cha Cha-Totah Gallup fields

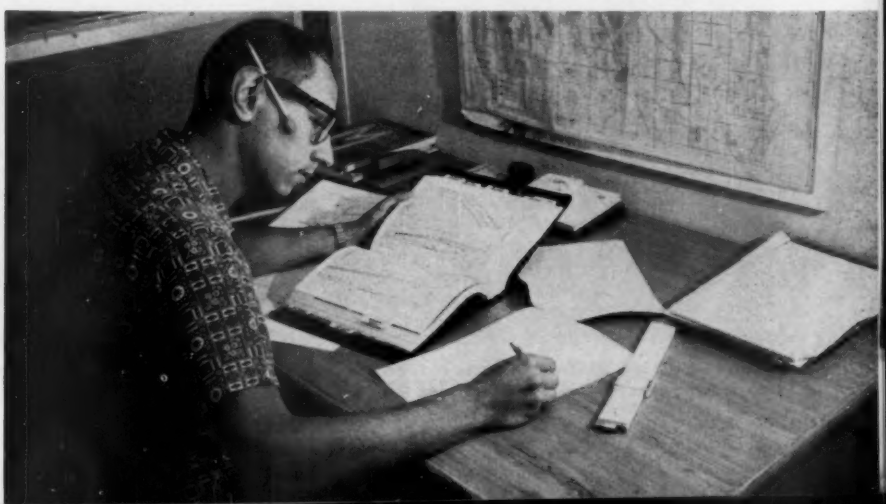


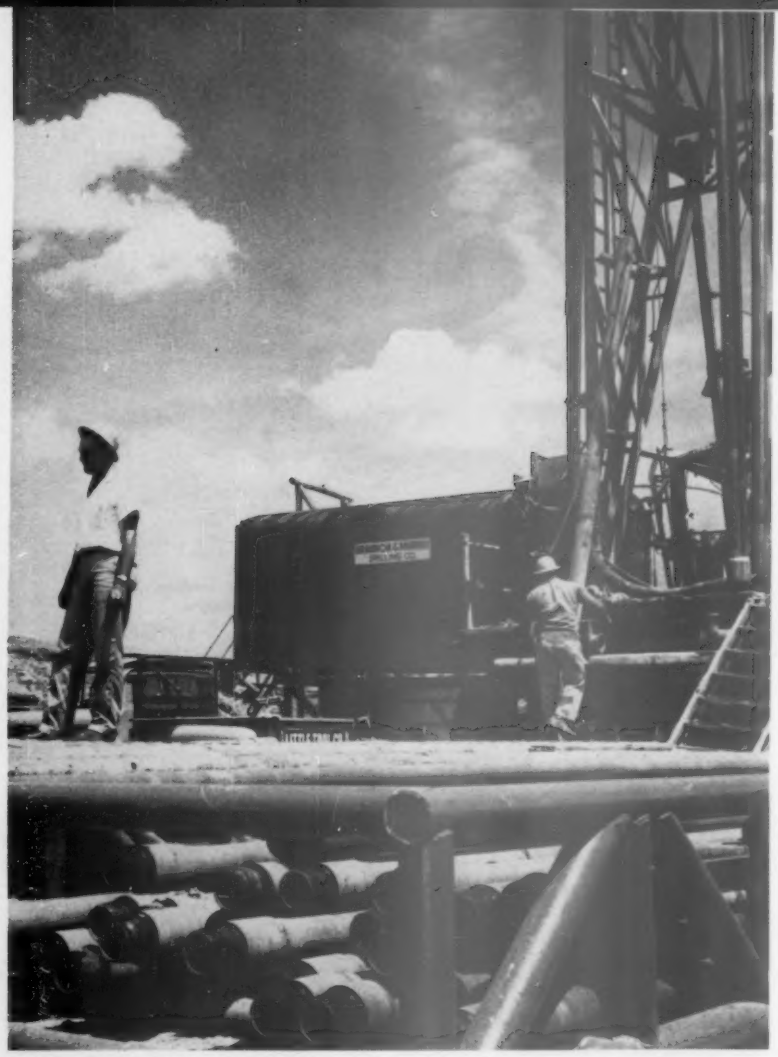
HERE IS PART of Cha Cha Gallup oil field near the City of Farmington in New Mexico. This San Juan River Valley field has the La Plata Mountains for a background.



CHA CHA AND TOTAH FIELDS are not yet defined. Extensions and stepouts are moving the production to the southeast. Drilling is now entering Gallegos Canyon.

DICK BANKS, Pan American petroleum engineer at Farmington, readies equipment design for water-injection system which will begin in Cha Cha Gallup this winter.





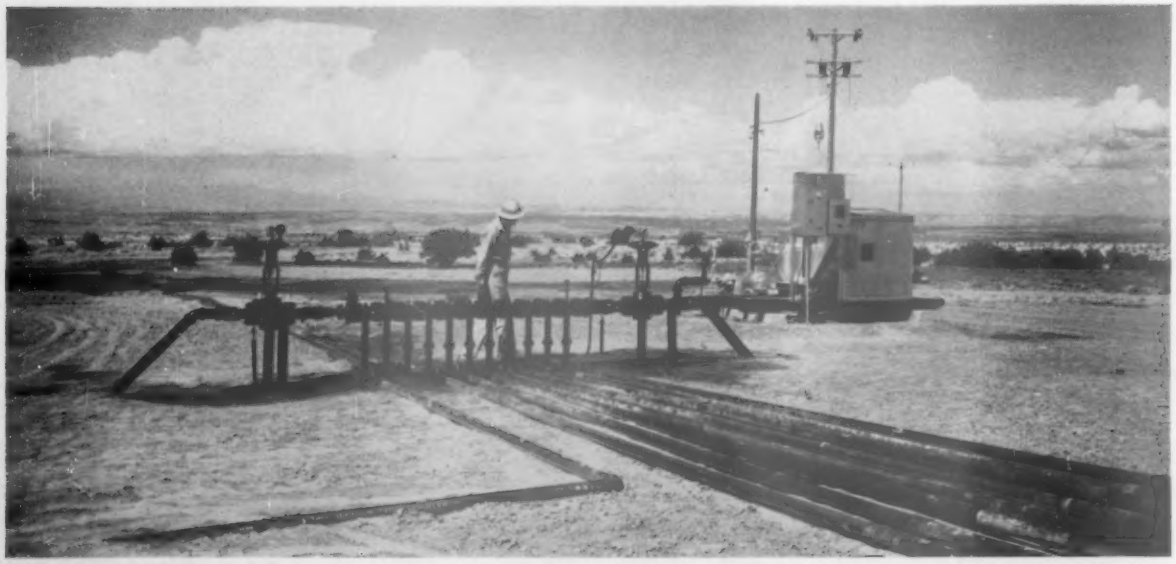
AVERAGE DRILLING TIME per well in Cha Cha is 13 days. This contract rig crew is busy drilling on one of the dozen active locations in the area.

at Cha Cha, Totah 2,680. Principal operators in the area are Pan American Petroleum Corp., Aspen Crude Purchasing Co., Aztec Oil & Gas Co., Benson-Montin-Greer, El Paso, Humble, and Tenneco at Cha Cha; Pan American, E. E. Elliot, Southwest Production Co., and Tenneco at Totah. Allowables are unusually good at 164 bbl. daily per well. Such output is allowed due to ready West Coast oil market.

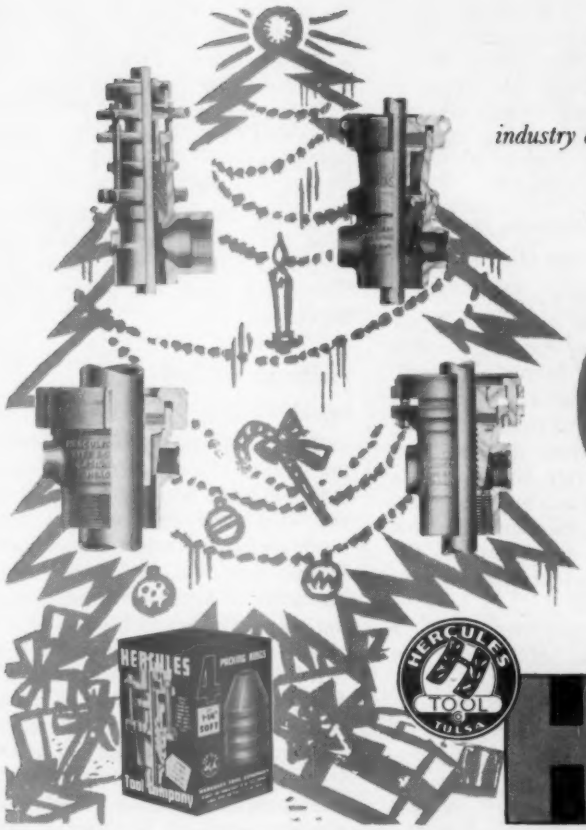
Future considered. Both Cha Cha and Totah are expected to have a shorter life than is normal. Pan American Petroleum Corp. took the initiative in making early plans for secondary recovery. Water flooding will begin this winter on a few Pan Am leases in the Navajo Reservation. Neither of the fields is defined as yet. Extensions are moving right along, to the southeast of both fields, with stepouts into the Gallegos Canyon area and across the San Juan River in the opposite direction.

An early end to flaring is expected in the two fields. An outside contractor working for all operators in the two fields has laid 20 miles of gathering lines to collect and compress gas for delivery. These two fields have reached a stage of maturity that takes most fields a decade.

Active tests. There are a dozen active tests in the two-field area.



PUMPER HOSEA BROWN inspects manifold at LACT unit in New Mexico's booming Cha Cha Gallup field. This unit handles 13 producers.



Forgetting for the time, the problems of our great industry and pausing to remember our many blessings, our friends and our progress, we want to wish you a very

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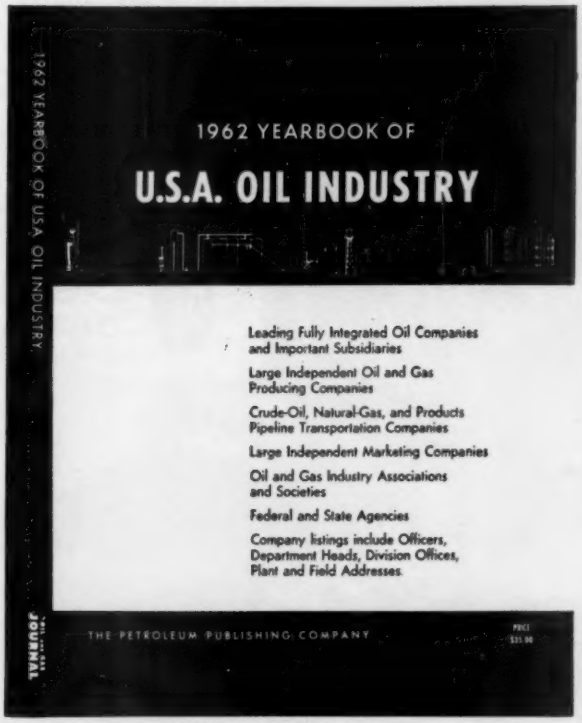
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THE PETROLEUM PUBLISHING COMPANY
JOURNAL

Pay zone is in the Upper Cretaceous Gallup at 5,150-5,250 ft. and the Cretaceous-Dakota at 6,100-6,200 ft. Totah has 10 dually completed Dakota and Gallup wells. Geologic markers include Pictured Cliffs sand at 1,200 ft., Lewis shale at 1,400 ft., Point Lookout sand at 5,300 ft., and Dakota sand at 6,100 ft. The trap is a stratigraphic lenticular sand associated with a monocline. Estimated recovery is 91 bbl. per acre-ft. A dry hole costs about $35,000, a flowing producer $57,000. Pumpers cost about $65,000.

Best since Bisti. This part of the basin has had many story-making discoveries in recent years, starting with Bisti Gallup field. This oil discovery sparked a new oil-hunting era for a basin of gas. Later discoveries at Gallegos, Verde, and Horseshoe Canyon added still more oil reserves to this biggest of Rocky Mountain gas arenas. Totah and Cha Cha Gallup fields, lying side by side, are far from drilled-up. All of these oil finds in the past few years have given San Juan basin interests much to take note of. Gas remains a prize target here, too, but like Green River in Wyoming, most people have always associated San Juan with gas. Now Green River is becoming a major oil producer as well as keeping its gas honors. San Juan now is entering the oil ranks.

Northwest Arkansas gets Mississippian gas discovery

A Mississippian sand has proved gas-productive in a new Arkoma basin discovery by Ambassador Oil Corp. in northern Franklin County, northwestern Arkansas.

It opens the third field in Arkansas to produce from that horizon. All other production on Arkansas's side of Arkoma basin has been from Pennsylvanian Atoka and Morrow sands. That in other parts of the state is from Cretaceous and Jurassic rocks.

Ambassador's discovery well, 1 Federal-Arkansas, produces from the lower Wedington sand at 2,348-58 ft. As in the two other Mississippian field, the production is small. Rated open-flow potential is only 525,335 cu. ft. daily.

Location is on the north edge of the basin proper, and 4 miles north of Jethro field nearest field. Jethro is gas-productive from both the Atoka and Hale (Morrow) sands.

Brentwood and West Fork, the other two fields with Mississippian gas production, are in Washington County, 15 to 20 miles farther northwest. Brentwood is productive from the Wedington member, and West Fork from the Sylamore. There, the sands are at depths of 500 to 600 ft..

Arkoma action boosted by two tests

The stepped-up drilling activity on Arkansas' side of the two-state Arkoma basin is being bolstered by two exploratory tests being started by Wheeler & Ryan, of Tulsa, and by the proposed drilling by these operators of at least 12 others during the next 18 months.

One of the two starting wildcats is a projected 12,000-ft. test on the East Ranger anticline in Yell County, on the southeastern fringe of the Arkoma play. The other is a 6,000-ft. test on the Midland anticline, in the southeastern corner of Sebastian County, south of Fort Smith, and near the Oklahoma line.

Programed for the next 18 months is one well in the Spadra area of northern Logan County, and 12 wildcats scattered through Yell, Logan, Scott, Sebastian, and Conway counties.

Mobil Oil Co., Halliburton Oil Well Producing Co., Sun Oil Co., Ambassador Oil Co., Sunray Mid-Continent Oil Co., Solar Drilling Co., and Petroleum Consultants, Inc., are participating in the program.

Wheeler & Ryan have been drilling on three other wells in the basin. They include one well in the Dover area, of Logan County; and two in Gragg field, in Sebastian County.

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Alberta well is oil discovery

OIL IS REPORTED at a Kaybob area wildcat in West-Central Alberta. Production is from the Triassic at Hudson's Bay Oil & Gas Co., Ltd., and Union Oil Co. of Canada, Ltd., 11-21 Kaybob on LSD 11, 21-62-20w4.

Flow came from a 28-ft. interval

just below 6,900 ft. A flow of 50 bbl. of oil was recorded during a 1-hour test. Coring has been resumed. This new discovery is near a pair of wells drilled by the same team, both of which found gas. The 11-27 Kaybob, 1½ miles northeast of the oil strike, found gas in both Cadomin and Beaverhill Lake. The 4-24 Kaybob, 3 miles east, found gas in the Viking sand. Kaybob Beaverhill Lake field is 8 miles northeast of the new gas find. Peace River Oil Pipe Line Co.'s line lies 3¼ miles east.

A third location was staked in the Milligan Creek area of northeastern British Columbia by Pure Oil Co.

The new well, third in the winter program which calls for at least four in the area, will go to the Halfway formation. It is being drilled on lands acquired under farmout agreement from Richfield Oil Corp.

The new well is Pure d-61-D Roc Donis on Quarter Unit d, Unit 61, Block D, NTS Map No. 94-H-2. It is 8½ miles southwest of Milligan Creek oil field and 4 miles southeast of Pure d-89-D ROC Firebird a middle Gething gas discovery. The first well in the program, Pure et al. d-88-F Sam, recently dry at 3,848 ft., is 7 miles northeast. The second test, a tight hole, is Pure et al. d-67-G Milligan, 9 miles northeast.

An active southeastern Saskachewan operator, Kissinger Petroleum Ltd., has had high success in drilling the past year. The latest wildcat try near Workman, a few miles east of Carnduff field, indicated oil in the Frobisher section of the Mississippian.

This potential discovery marks the twenty-sixth oil well for the firm and its partners in this general region. It also marks the fourth new field discovery. Kissinger's team has also drilled four dry holes in the year's campaign.

Kissinger's area of interest lies in the region from the Manitoba border west to the Estevan area and from the international boundary about 45 miles north. Success ratio has been high, completions are good, light-gravity oil is at a premium in the area, and a ready market at good wellhead price promises quick returns for investment.

Kissinger is using its own subsidiary drilling firm for most of the wells in the program. With 30 wells completed and at least five more planned before January 1, this group will account for about 6% of all drilling in Saskatchewan this year. Most of the wells drilled have been put down by Kissinger, United Canso Oil & Gas Ltd., and Consumer's Cooperative Refineries Ltd. with a majority of the wells on farmouts.

Latest find. The newest discovery prospect is Kissinger et al. 7-2 on LSD 7, 2-2-32w1. A drill-stem test at 3,959-61 ft. got 700 ft. of clean oil and 120 ft. of heavy oil-cut mud. This well will be completed immediately. The rig will move to a new site on LSD 5, 1-2-32w1. With its drilling program crossing the border into North Dakota, Kissinger & Associates are planning a very active drilling campaign with a pair of rotaries.

Half-mile extension to Riceville field recorded

Riceville field, in northwestern Vermilion Parish, coastal Louisiana, has a half-mile southwestern extension.

Alberta's 19 meat packing plants, with 4200 employees, process $190 million worth of meats while $6 million worth of farm products are processed by six canneries for national distribution
Although Alberta produces all types of food, food imports into the province last year totalled $14 million. For example 745,000 gallons of pickles are consumed annually by Albertans, but less than 2% of these are pickled in the province
Potatoes, beans, peas, corn, etc., are carefully handled by girls at one of the many processing plants in Alberta. Our food industry employs 12,000 persons with the annual payroll in excess of $45 million
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Director of Industrial Development
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PROVINCE OF ALBERTA

Born in Outlook, Saskatchewan, ex-serviceman, ex-school teacher, Art Evoy has been interested in art since his early childhood. Accomplished in the fields of watercolor and oils, as well as pencil as in this sketch, Mr. Evoy has been a commercial artist for the past eight years in Edmonton, where he has also earned a reputation as a musician. This is the second in a series of industrial advertisements displaying the abilities of Alberta artists.

Trice Production Co.'s 1 Broussard, extension discovery, flowed 248 bbl. of condensate with 4,500 M.c.f. of gas daily through 12/64-in. choke.

Completion is in the Camerina sand at 14,858-70 ft. with hole plugged back from total depth of 16,950 ft.

Mississippi strike taps Tuscaloosa

ARGO Oil Co. is completing an indicated Tuscaloosa discovery well 1¼ miles north of its recently completed Tuscaloosa discovery in the Cannonsburg area of southern Jefferson County, in southwestern Mississippi.

The new well, 1 White-Krauss Unit, has 23 ft. of net gas sand in a Lower Tuscaloosa stringer at 9,981-10,010 ft., and 8 ft. of gas and 13 ft. of oil sand in the Massive sand at 10,016-38 ft.

In a precompletion drill test with casing perforated at 10,016-21 ft., 4 ft. above the gas-oil contact, the well flowed at the rate of 300 bbl. per day with a 15/64-in. choke. Gravity of the oil was 42.8°. Top pressure gaged 1,572 psi. with gas-oil ratio of 3,067 cu. ft. per bbl.

Argo's Cannonsburg discovery well, completed last October, flowed 247.49 bbl. of 42.9°-gravity oil per day through ¼-in. choke from pay at 10,076-86 ft. Flow was with about 11 bbl. of water daily. Pressure was 1,100 psi., and gas-oil ratio 3,000 cu. ft. per barrel.

Two oil pools, one gas pool, in Illinois in November

Two new oil pools, Enfield South in White County, and Opdyke in Jefferson County, and one new gas pool, Beaver Creek Northeast in Bond County, were discovered in Illinois in November.

There were also five extensions to oil pools, as follows: one each to Clay City West Consolidated, Louisville North, and Sailor Springs Consolidated, all in Clay County; Edinburg West in Sangamon County; and Newton West in Jasper County.

A total of 215 new oil and gas tests was completed during November. The new tests resulted in 94 oil wells and 11 gas wells. In addition, 10 miles that previously had been completed as dry holes were reworked or deepened and recompleted as oil wells.

Seven deep wells that tested the Dutch Creek sand in the deep part of the Illinois basin were reported completed in November, all in Wayne County. Total depths ranged from 5,400 to 5,500 ft. Six of the deep wells were in or near Goldengate Consolidated pool. Four of these were completed as oil wells in the Dutch Creek sand, with initial potentials of from 70 to 126 bbl. of oil a day, and two were dry holes. The other well was drilled about ⅝ mile from production in Aden Consolidated pool and completed as a dry hole. Dutch Creek sand production was discovered in Goldengate Consolidated pool in August of this year, and in Aden Consolidated pool in 1959.

Estimated production for Illinois in November is 6 593,000 bbl.

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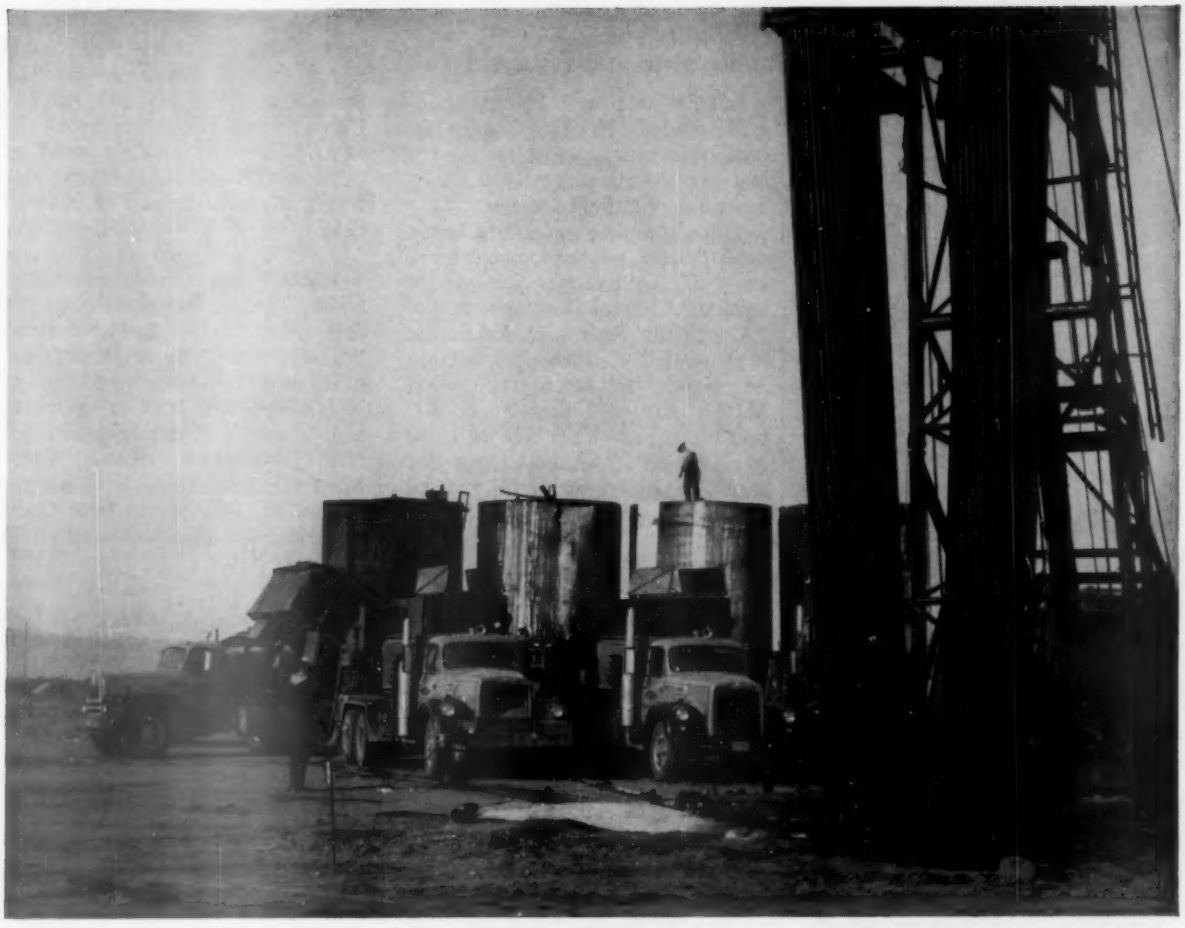

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Many of the advancements in the fracture treatment of wells are direct Dowell developments. Here are some of the important fracturing services and products available from Dowell to help make your fracturing treatments profitable.

*THE FRAC GUIDE**— Dowell's method for planning and predicting the results of fracture treatments — helps operators select the most profitable treatment for any well. An electronic computer service may be used to provide faster, more accurate calculations based on the Frac Guide.

*SANDFRAC** fracturing service employs either refined oil or lease crude to carry the propping agent. Overall costs are generally low because the fracturing fluid can usually be sold along with well production.

WATERFRAC fracturing service uses thickened fresh or salt water as the fracturing fluid. Excellent sand-suspending qualities and low fluid loss rates help provide high-efficiency treatments.

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Hocking, Ohio, action spills over into Fairfield

In Ohio, interest in Pennsylvania-grade crude in Hocking County has stimulated action across the county line into southeast Rush Creek Township, Fairfield County.

Three completions in the Clinton sand, Petroleum Development Service 1 E. L. Everett, Section 25: Dynamic Mineral Development Co. 1 S. Helmuth, Section 25 and Bristol Hackbusch 2 P. Tschappel, Section 36, tested after fracture, 3,000 M.c.f.d. and rock pressure of 800 psi.; 60 barrels oil per day with 200 M.c.f.d. and 75 barrels oil per day with 200 M.c.f.d. respectively. Total depths were 2,834, 2,771, and 2,716 ft.

A good gas strike was reported by the Ohio Fuel Gas Co. in southeast Salt Creek Township, Hocking County. The 1 Joanna Bowers, Section 1, a stepout of more than a mile, had a natural gage of 3,220 M.c.f.d. while still in the Clinton pressure was 759 psi.

Sooner drilling sets fast pace

OKLAHOMA developments continue to move along briskly with important happenings reported throughout the state.

Tidewater Oil Co. completed its Atoka Pennsylvanian sand gas discovery in northern Canadian County, Central Oklahoma. The 1 James Paint Yellow in C NW SE 28-14n-9w flowed 4,800 M.c.f.d., open flow. Perforations were at 9,668-9,740 ft.

Woods County. L. S. Youngblood and Van-Grisso Oil Co. 1 Cline, C NW SE 19-29n-14w, just south of Kansas line, flowed 3,850 M.c.f.d., calculated open flow. Perforations are in the Mississippian at 4,962-72 ft.

McClain County. Final flow tests at Sun Oil Co. 1 Anderson in C NW NW 35-6n-4w, Southwest Criner field, McClain County, made 169 bbl. of oil in 18 hours on 12/64-in. choke; 171 bbl. in 23 hours on 12/64-in. choke; 153 bbl. in 24 hours on same choke. Production is from perforations at 11,942-11,990 ft in Bromide Ordovician.

Harper. In northwestern Oklahoma's Harper County, Pan American Petroleum Corp. completed 1 State-W in C SW NE 17-27n-25w, Laverne district, flowing 2,370 M.c.f.d. from Morrow sand at 6,596--6,600 and 6 631-35 ft. This well is in the north part of Laverne field.

Blaine County. In Western Oklahoma, Texaco Inc. announced the first offset for its new Northeast Watonga field. The 1 Hazel Dyke, C SE NW 12-16n-11w, will go to Atoka or 9,350 ft. The discovery well is west at 1 Swanegan in C SE NE 11-16n-11w. It flowed 5,400 M.c.f.d. and 62 bbl. condensate per day on 12/64-in. choke from Cherokee Pennsylvanian perforations at 9,030-77 ft.

New well added to Oklahoma's North Carter field in Beckham County

Potential test was reported at Shell Oil Co. 1 Ambruster in C NW NW 16-9n-22w, on the southeast side of North Carter field in Beckham County, western Oklahoma.

Flow was 12,900 M.c.f.d. from Missouri Pennsylvanian at 8,131-34 ft.

Blaine County. Texaco Inc. made 4-point test at 1 Maier-Bolen in C SW NE 5-15n-13w, the third well in new East Fay field.

The well flowed 18 bbl. of condensate and 1 M.M.c.f.d. on 6/64-in. choke from Morrow Pennsylvanian sand perforations at 10,290-10,314 ft., 7 bbl. condensate and 1.650 M.c.f.d. on 9/64-in. choke; 5½ bbl. condensate per hour and 1,875 M.c.f.d on 12/64-in. choke; 4,520 M.c.f.d. and 11 bbl. condensate in 1 hour on ¼-in choke. Open flow is 13-14 M.M.c.f.d.

Dual completion reported at Kingfisher wildcat

A wildcat east of North Dover field in Kingfisher County, Oklahoma, was dually completed in Big Lime and Oswego. The well is United Producing Co. 1 Clements iin C NE SW 17-18n-6w.

Pump got 63 bbl. of oil per day from Big Lime perforations at 6,323-62 ft.; flow was 65 bbl. per

day from perforations in the Oswego at 6,451-73 ft. on 20/64-in. choke.

Champlin Oil & Refining Co. has extended the northwest side of Northwest Columbia field at 1 Vadder in C SW NE 8-19n-5w. The well recovered gas and oil on drillstem test at 6,121-75 ft. in Oswego.

Sunray Mid-Continent Oil Co. 1 Terrell, C SE NW 12-17n-6w, extension well on the northwest side of Southeast Lincoln field, flowed 147 bbl. of oil in 16 hours on 12/64-in. choke from Oswego perforations at 6,308-22 ft. Completion will also be tried in the Meramec at 6,720-7,018 ft.

Gulf Oil Corp. completed 2 Merritt-Moore in C NE SE 13-18n-7w, North Dover field, flowing 51 bbl. of oil in 22 hours on 14/64-in. choke from Manning Mississippian perforations at 6,904-44 ft.

New oil field for Jefferson County, Texas

An exploratory test east of the large Stowell field, in western Jefferson County, Texas Gulf Coast, has proved oil productive in a 7,800-ft. Frio sand, and is credited with opening a new field designated as East Stowell.

The well is Floyd Oil Co.'s 1 Rollins. It flowed at the rate of 170.38 bbl. of 38°-gravity oil daily on potential gage through 10/64-in. choke. Flow was under pressure of 625 psi. Gas-oil ratio was 1,235 cu. ft. per barrel. Its sand, in hole drilled to 8,521 ft., is perforated at 7,814-20 ft.

Quadruple discovery finaled in Upton County, West Texas

A quadruple discovery well was completed in southwestern Upton County, 10 miles northwest of Rankin in West Texas. The well is Odessa Natural Gas Co. et al. 1 Weir.

From upper Strawn Pennsylvanian perforations at 8,762-92 ft., the well flowed 418 bbl. of 43°-gravity oil per day on 32/64-in. choke. From Bend lime at 9,821-77 ft. it flowed 2,200 M.c.f.d. From middle Strawn at 9,270-4,422 ft. the well flowed 335 bbl. of oil per day on 20/64-in. choke. From lower Strawn perforations at 9,470-82 ft. the well made 2,700 M.c.f.d. Location is in Section 14, Block 2, MK&T Survey. Location is 4¾ miles northeast of Fradean field.

Pecos County. TXL Oil Corp. 1 Pecos Fee, west-central Pecos County wildcat, flowed 4,425 M.c.f.d. from perforations in the Devonian at 14,544-14,700 ft. Location is in Section 137, Block 3, T&P Survey, 8 miles southwest of Belding field and 17 miles southwest of Fort Stockton. Total depth is 17,768 ft.

Humble opens gas area in Texas' Colorado County

A new gas-productive area for the Texas Gulf Coast has been opened in the southeastern corner of Colorado County.

Discovery is by Humble Oil & Refining Co. at its 1 Charles Kachele. It is completed with open-flow potential of 2,500 M.c.f.d. of gas from Wilcox sand at 9,253-65 ft.

Location is 2 miles south of Orange Hill field, across the line in Austin County, and about the same distance northeast of Chesterville field. Orange Hill, discovered in 1943, has two Wilcox gas wells with sands at 9,000 to 9,200 ft. Chesterville, also discovered in 1943, has both Cockfield and Wilcox gas production from 13 wells at comparable depths.

Third Fusselman Silurian well added to Inez field, Texas

The third Fusselman producer in newly opened Inez Multipay field in Andrews County, 16 miles southeast of Andrews, West Texas, is Pan American Petroleum Corp. 1 Midland Farms.

The well flowed 465 bbl. of 45.2°-gravity oil per day on 23/64-in. choke from perforations at 11,742-90 ft. The well was completed earlier this year as an Ellenburger discovery in the field and a Devonian gas well. Location is in Section 40, Block 41, T-1-N, G&MMB&A Survey.

In Hutex Multipay field, a new pay discovery is Humble 4 State University "QR". This old Devonian reentry flowed 231 bbl. of oil per day on potential test through 21/64-in. choke from perforations at 10,887, 10,896, and 10,901 ft. in Canyon lime. Location is in Section 15, Block 8, University Lands Survey.

Wyoming well is oil producer

ONE of the year's most important discovery wells in the Rocky Mountains was completed for a combined pumping potential of 1,000 bbl. daily. The well is Pan American Petroleum Corp.'s new-pay discovery in Elk Basin field, Park County, Big Horn basin, Wyoming.

The well pumped 500 bbl. of oil per day, 0.2% b.s. and w., from Jefferson Devonian perforations at 5,468-5,510 ft. Gage was 500 bbl. per day from Big Horn Ordovician perforations at 5,744-5,941 ft., cut the same as in the Jefferson. Gas-oil ratio in Jefferson is 11:1, oil is 28° gravity. Oil in the Big Horn is 26°, gas-oil ratio is 55:1. This wildcat went into the Flathead Cambrian, total depth 7,460 ft. There was some oil in the Cambrian. Oil was also recovered on tests of the Three Forks Devonian.

This discovery gives Elk Basin field seven pay zones. The well gives the Big Horn basin its first Devonian oil. Pan Am has two Cambrian tests drilling at 193 Unit in NE NE 31-58n-99w and 194 Unit in NW NE 24-58n-100w.

Two Uinta basin wildcats are indicated discoveries

Gas flowed at two southeastern Uinta basin wildcats in Grand County, Utah. Rip C. Underwood 1 Seagull-Federal, SE NW 13-16s-24e, flowed 15,000 to 20,000 M.c.f.d. from Dakota Cretaceous at about 5,606 ft. The two wells are 6 miles apart, between San Arroyo gas field on the east and Fence Canyon on the west. Tidewater Oil Co.'s 1-X Horse Point Unit in NW SE 14-16s-23e, 6 miles west of the above strike, flowed 1 M.M.c.f.d. from perforations in the Dakota at 8,008-8,094 ft.

The area between the two wells is completely untouched by previous drilling. There is also a 3-mile gap between Horse Point and Fence Canyon and 3½ miles from Underwood's strike and San Arroyo field. Nearest San Arroyo production is Sinclair 6 Unit in SW NE 21-16s-25e. This Dakota and Entrada well flowed 5,950 M.c.f.d. from Dakota at 5,731-32 ft. and 10,500 M.c.f.d. from Entrada at 6,490-6,510 ft.

PROFILE

Jobbers' big need: financing

. . . says George Calkins, new NOJC president. He sees lack of operating capital as a major curb on jobber growth.

GEORGE W. Calkins of Denver is confident there's still plenty of room in marketing for the good petroleum jobber to operate a successful business.

"The outlook is good," he says, "for the jobber who performs up to his ability and co-operates with his supplier. The jobber still performs a vital function in this business—in fact, one which the supplier can hardly duplicate."

Calkins is the new president of National Oil Jobbers Council. He will serve a 2-year term succeeding E. K. Bennett of Longview, Tex., who held the post the last 2 years.

The new NOJC president is a native of Denver and has spent all his business career in that area—25 years in oil marketing and 17 in jobber operations.

Calkins is so sold on the rule of the jobber in the marketing scheme he thinks ultimately most major suppliers may turn over their distribution to jobbers and devote their efforts to the education and training of good men for jobberships.

No easy job. Jobbers are going to have to become more aggressive to remain in business, Calkins warns.

"We must quit bickering among ourselves. Petroleum jobbing is a good business; and we must stop talking so much about what's wrong with it and talk about its good points.

George W. Calkins
". . . jobbers' role is vital."

"If we don't settle our own problems, the Government will start taking a look at us with the idea of regulation. That we don't want."

Calkins says jobbers have to overcome three major fears held by major suppliers. These are: the usual short business life of a jobber, lack of adequate financing, and his business ability.

"The jobber needs some way of acquiring long-term financing," Calkins says. He explains that lack of operating capital often limits a jobber's growth potential. NOJC officials plan to investigate availability of federal small-business loans to help jobbers caught in this predicament.

Calkins adds that jobbers' stature would gain with suppliers if more jobbers would operate their business "for the long haul."

"The jobber shouldn't be so quick to sell out," he says. "He should operate with the idea of staying in business, building something for his children, of training them in management, and keeping the business in the family. That approach gives stability to the jobber and makes his role more attractive to suppliers."

Success story. Calkins got into oil marketing in 1936 as an employe of Texaco Inc.

He joined a jobber partnership in 1944 in Denver, with Texaco as the supplier, and in 1948 purchased the entire operation. In 1949 Calkins changed to Phillips Petroleum Co. as supplier when Texaco decided it did not want a jobber in the Denver market.

Calkins' firm is the Merchants Oil Co., and it has enjoyed a phenomenal growth in Denver. Starting out with 140,000 gal. per month, the company now sells 1,300,000 gal. per month. It services 56 outlets, some of which the company owns or leases.

Calkins was born, reared, and educated in Denver, and he tells you he intends to stay there. He's a likeable, energetic, and capable executive who's experienced in NOJC affairs and devoted to jobber interests.

It's sheer understatement to say he's the popular choice for NOJC president.

Lowell Newmyer, manager of Cities Service Co.'s natural-gas department, New York, has been named president of Cities Service Helex, Inc., new company which will operate the Cities Service helium extraction plant to be built at Satanta, Kans. Other officers of the company will be **John L. Gere,** Cities Service Gas Co., Oklahoma City, vice president; **Donald A. Hamilton,** Cities Service Gas, Oklahoma City, secretary-treasurer; **Kenneth Manner,** Cities Service Gas, Oklahoma City, assistant secretary; and **E. W. Lamparter,** also with Cities Service Gas, Oklahoma City, assistant treasurer. **H. E. Bockelken,** Cities Service, New York, will be assistant secretary and assistant treasurer of the new company. Directors will be **K. E. Crenshaw,** president of Cities Service Gas; Newmyer; Gere; Hamilton; **Charles Wheeler,** Cities Service Gas; **M. O. Thomas,** Ulysses, Kans., division superintendent; and **M. J. Weckerling,** superintendent of Hugoton station, Satanta, Kans. The new helium plant will be supervised by **W. H. Heyland,** project engineer, and **J. D. Harlan, Jr.,** process engineer.

James Felix, section head in process research for Esso Research & Engineering Co., has been named assistant director of the process-research division. He succeeds **Al Patterson,** recently transferred to the petroleum - development division's senior staff. Also at Esso Research, **Bill Goryl,** assistant director in the

general engineering division, has been given a 1-year assignment as assistant director of products research. He succeeds **L. B. Shore,** now on rotational assignment with the marketing department of Esso Standard Eastern, Inc.

Donald L. Shoop, production engineer with Pan American Petroleum Corp., has been transferred to Worland, Wyo., from Kimball, Neb.

Thomas L. Craig has been named manager of Commonwealth Oil Refining Co.'s petrochemicals plant under construction near Ponce, Puerto Rico. He will supervise engineering and design during the unit's construction and will be responsible for operations after the plant goes on stream in early 1962. Craig had been production superintendent at U. S. Industrial Chemical Co.'s Tuscola, Ill., plant.

Ralph D. Hawkins, geologist with Shell Oil Co. in Ventura, Calif., has been transferred to Bakersfield, Calif., in the same capacity.

Dorman N. Farmer, Wayne Petroleum Co., has been elected 1962 president of Abilene, Tex., Geological Society. Other new officers include **Jimmy W. Sojourner,** Sojourner Drilling Corp., vice president; **Ralph S. Bridwell,** Bridwell Oil Co., secretary; **George C. Fraser III,** consultant, treasurer; **R. B. Vickers,** T.P. Coal & Oil Co., representative to the Southwestern Federation of Geological Societies; and **Arthur L. Jenke,** consultant, alternate SWFGS representative.

C. R. Paul, Phillips Petroleum Co., is newly elected president of the Oil Marketers' Club of Tulsa. Serving with Paul will be **Robert D. Phillips,** Pemco Oil Co., vice president; **H. B. Sikes,** Sinclair Refining Co., secretary; and **Edwin C. Smith,** E. C. Smith Oil Co., treasurer. Directors will be **C. E. Gardenhire,** Texaco, and **Truman McCoy,** American Petrofina Co. of Texas.

William A. Nichols, Baton Rouge, La., marketing district manager for Humble, has been transferred to New Orleans as service station and reseller sales coordinator for the 10-state southeastern region. Nichols succeeds **T. F. Smith,** recently named Memphis area manager. **Maurice Geisel** will succeed Nichols in Baton Rouge. In other southeastern marketing changes, **Ted B. Miller,** Shreveport, La., district manager, has been named sales manager for the New Orleans area. **Lewis H. Unglesby, Jr.,** assistant district manager in Shreveport, will succeed Miller there. **James A. Lightfoot,** New Orleans district manager, has been named reseller, aviation, and LPG manager for the New Orleans area. **Joseph V. Bres** will succeed Lightfoot.

Harry E. Keegan, assistant superintendent of Union Oil Co.'s central division in Midland, Tex., has been promoted to division superintendent. He succeeds **James S. McNulty,** who has been promoted to superintendent of field operations for the northern Pacific Coast division in Bakersfield, Calif. McNulty has been division superintendent in Midland since 1949.

R. L. Wagner, administrative vice president of Great Lakes Pipe Line Co., has been elected president and a director. He succeeds **Harry Moreland,** who has retired as president but will continue as a consultant to the company. Wagner joined Great Lakes in 1949 as general counsel. He has been administrative vice president since 1956.

Harold G. McHardy, assistant to the superintendent of transmission and distribution, western area, for Union Gas Co. of Canada, has been named superintendent of compressor plants. **William B. Dyer,** geologist, has been named superintendent of gas dispatching for the company.

Anthony Belcastro, western pipelines district engineer for Ohio Fuel Gas Co., has been promoted to general engineer in the pipelines department, Columbus, Ohio. **Paul R. Liimatta** has been named junior industrial engineer in the north central district with headquarters in Mansfield, Ohio.

PERSONALS

Vernon L. Horte, manager of gas supply for Trans-Canada Pipe Lines, Ltd., has been named vice president, gas supply. He will continue to headquarter in Calgary. Horte was with Alberta Oil and Gas Conservation Board and DeGolyer & MacNaughton before joining Trans-Canada as chief gas-supply engineer in 1957. He became manager of gas supply in 1959.

Charles E. Carter and **William A. Graul** have been named associate directors of commercial development in Gulf Oil Corp.'s petrochemical department. They will headquarter in Pittsburgh.

Robert E. Gore, supervisor of Ohio Oil Co.'s marketing-engineering department, will retire January 1 after almost 42 years with the company. **Lemuel McManness,** construction engineer, will succeed Gore.

R. G. Renaudin, Gulf Oil Corp., has been elected chairman of Louisiana Petroleum Council. He succeeds **H. J. Geiger,** Humble. **Dean L. McGregor,** Continental Oil Co., has been named first vice chairman with **Walter Allred,** Texaco, as second vice chairman, and **D. R. Martin,** Shell Oil Co., as secretary-treasurer. **Leland E. Alfred,** Cities Service, and **Oma R. Bates,** Humble Pipe Line Co., have been named to the executive committee. **J. R. Major** is director of the council and **Jack Francis** is associate director.

D. A. Nicewander, plant superintendent of Shell Oil Co.'s Sheridan, Tex., cycling plant, has been named plant superintendent of the Bryans Mill gas plant facilities in the Houston area gas department. **R. H. Torrance,** assistant plant superintendent in Sheridan, has succeeded Nicewander. **D. B. McNeely,** gas engineer in Sheridan, has been named operations supervisor there, a new title replacing the one formerly held by Torrance.

Marvin W. Crowe has been named U. S. market development representative for Conch Methane Services, Ltd., London. He will headquarter in Houston, where he has been director of personnel development for Continental Oil Co. Continental is a part owner of Conch International Methane, Ltd., parent of Conch Methane Services.

Daniel E. Hendricks, Jr., has been named manager of Shell Oil Co.'s new LPG sales department. He will headquarter in New York. Managers of the new department's four marketing areas are **Edwin J. Colerick,** Baltimore; **Victor R. Storey,** Chicago; **Charles F. Dexheimer,** Houston; and **Thomas S. Johansen,** San Francisco.

E. L. Shannon, Jr., vice president of Santa Fe Drilling Co., Whittier, Calif., has been elected executive vice president, a new position.

H. E. Redd, chemical marketing representative for Gulf Oil Corp. in Houston, has been transferred to London where he will coordinate Gulf's petrochemical marketing in Europe.

Burt Beverly, Jr., retired manager of exploration and production for Arabian American Oil Co. in New York, has joined Harry Wassall & Associates, Inc., as consulting geologist in Geneva, Switzerland.

Richard B. Meyer, geologist with Sinclair Venezuelan Oil Co. in the company's Santa Barbara camp, Venezuela, has returned to the U. S. as geologist with Sinclair Oil & Gas Co. in Casper, Wyo.

Ernest C. Dearman and **Gerald W. Spotts** have joined Shell Chemical Corp.'s Union, N. J., laboratory as engineers in the plastics department.

Paul Talmey, a director and vice president in charge of research and development for General American Transportation Corp., has been named director of market research. Also **William O. Graham** has been named director of purchases; **Emerson J. Lyons** has been named head of the new coordinated-equipment division; and **Charles L. Cogswell** has been appointed manager of the government division. **Harlan J. Thompson,** manager of operations at the Compton, Calif., plant of Fuller Co., a subsidiary, has been named Sharon, Pa., plant general manager. **E. J. Kelly,** process-equipment engineer, has been named manager of the process-equipment department.

Ted Schmidt, junior production engineer with British-American Oil Producing Co., has been transferred to Sterling, Colo., from Kimball, Neb.

J. D. Davis has been named chief representative in Japan for Esso Standard Sekiyu, KK, new subsidiary of Standard Oil Co. (N. J.) formed to take over Jersey's share of Standard-Vacuum Oil Co.'s Japanese assets. **E. S. Checket** will be chief

DAVIS

CHECKET

representative in Japan for Mobil Sekiyu, KK, new Socony Mobil Oil Co. subsidiary which will take over Socony's Stanvac assets in Japan (for details on division of the Japanese Stanvac interests see p. 63). Davis will be assisted in Esso Sekiyu marketing operations by **R. D. Everest, E. C. Staber,** and **M. Okada.** Checket's marketing assistants will be **E. P. Edmunds, P. K. Hixson,** and **T. Morita.**

Ed Unger, manager of the Oklahoma City district of C. L. McMahon, Inc., has joined Forest Oil Corp. as West Texas-New Mexico division geologist. He will headquarter in Midland, Tex.

Dr. Donald D. Dunlop, senior engineer with Esso Research Laboratories in Baton Rouge, La., has joined Oil Recovery Corp. as assistant manager of research and development at the company's Norman, Okla., research laboratories.

James E. Crawford, Jr., St. Louis, has been named assistant general manager of Monsanto Chemical Co.'s plastics division. He had been director of marketing for the inorganic chemicals division. In other plastics division appointments, **Robert C. Soderberg,** styrene-products administrator, has been named director of product administration. **J. Virgil Waggoner,** director of raw-materials sales, will succeed Soderberg. **Richard T. Clark,** director of vinyl-products sales, will replace Waggoner. **Chester L. Knowles, Jr.,** manager of development engineering in Springfield, Mass., has been named vinyl-products administrator.

E. L. Davis, district manager for Shell Oil Co. in Evansville, Ind., has retired after 28 years with the company.

Dois Dallas, Dallea Petroleum Corp., Tioga, N. D., has been elected 1962 chairman of AIME's North Dakota section of Society of Petroleum Engineers. **Robert Slaby,** Texaco, has been named first vice chairman with **Donald Torgerson,** Dowell, as second vice chairman. Both are from Williston. **Dale Lalim,** Dallea Petroleum, Tioga, has been elected secretary-treasurer.

Patrick L. Driscoll, operations supervisor for Champlin Oil & Refining Co.'s Rocky Mountain district, has joined Chief Mountain Co., Denver.

F. M. Dwyer, chief scout for Canada-Cities Service Petroleum Corp. in Calgary, has been elected president of Western Canadian Oil Scouts Association. Other new officers include **Bruce Freeborne,** Union Oil Co. of Canada, vice president; **Bernie Ellingson,** Richfield Oil Corp., secretary; and **Con McInnes,** Texaco Canada, treasurer. **Jerry Sampson,** Pacific Petroleums, is outgoing president of the group. The new officers will take over January 1.

Dr. Zigmond W. Wilchinsky has been named research associate in Esso Research & Engineering Co.'s chemicals-research division.

Ralph H. Viney, oil and gas consultant, has moved his offices to Midland, Tex., from Fort Worth.

D. D. Wright has been named production superintendent for Triad Oil Co., Ltd. He will be responsible for all production and engineering activities. Wright succeeds **G. F. Skelton,** who is returning to British Petroleum Co.'s London office. **Dr. John Lacey** has been named chief reservoir engineer for Triad and **A. F. Burchnall** has been named petroleum engineer.

WRIGHT

Leonard W. Brock, assistant chief petroleum engineer for the Long Beach, Calif., Harbor Department, has been promoted to administrator of city petroleum properties, a new position. Brock has been with the harbor department since 1953.

Bill W. Davis, sales manager for Allied Oil Co., Cleveland, a division of Ashland Oil & Refining Co., has been elected a vice president of Allied. **Wayne T. Wiggins,** assistant sales manager, will succeed Davis as manager. **Dwaine E. Gullett,** sales representative, will succeed Wiggins.

R. E. House has been named special representative for Tennessee Colombia, SA, subsidiary of Tennessee Gas Transmission Co. He will headquarter in Bogota. House formerly had served as chief geologist for Tennessee del Ecuador, SA, and senior geologist for Chaco Petroleum, SA, another affiliate, in Bolivia.

Richard D. Bates, junior mechanical engineer for Shell Oil Co. in Houston, has been transferred to Farmington, N. M., as mechanical engineer.

Elmer R. Hancock, chemical engineer with Gulf Research & Development Co. in Philadelphia, has been transferred to Irwin, Pa., where he will be supervisor of the chemical analysis laboratory in the technical-service division.

Howard G. Johnson, vice president and general manager of Hunter Drilling, Ltd., Calgary, has been elected president. Johnson has been with Hunter since 1958. He had been with Hughes Tool Services, Ltd., and Canamerican Drilling, Ltd., before that time.

Dr. Milton S. Konecky and **Dr. James E. Shewmaker** have been named research associates in Esso Research & Engineering Co.'s chemicals-research division. Konecky has been with Esso Research since 1957, Shewmaker, since 1951.

Raymond T. Stotler, Jr., Pan American Petroleum Corp., has been elected 1962 president of Fort Worth Geological Society. He succeeds **Arthur S. Gale, Jr.,** Champlin Oil & Refining Co. Other new officers include **Russell Farmer,** Hill & Hill Oil Producers, first vice president; **Ray Evans,** Welex division of Halliburton Co., second vice president; **Victor King, Jr.,** Champlin, secretary; and **Herbert E. Ware,** consultant, treasurer.

James J. Kelly, vice president of Kerr-McGee Oil Industries, Inc., has been elected chairman of the Asphalt Institute. He succeeds **L. P. Street,** American Bitumuls & Asphalt Co. **E. F. Shannon,** Continental Oil Co., has been named senior vice president of the institute. Vice presidents for geographical districts will be **Robert C. Hawks,** Mobil Oil Co., New York; **Kenneth E. Gardner,** Phillips Petroleum Co., Bartlesville, Okla.; **Robert S. Ketcham,** APCO Oil Corp., Oklahoma City. **Cyril E. Cox,** Humble, Billings, Mont.; **John J. Shelly,** Ashland Oil & Refining Co., Ashland, Ky.; **J. N. Jones,** American Bitumuls & Asphalt, Cincinnati. **S. J. Diegel,** Sinclair Refining Co., Kansas City; **D. L. Nielsen,** Union Oil Co., Los Angeles; and **E. J. Barnes,** Edgington Oil Refineries, Long Beach, Calif. Hawks has been elected treasurer of the institute, succeeding **L. B. Fox,** Mobil Oil Co.

KELLY

Audley D. Morden, Roswell, N. M., consulting geologist, has joined James G. Brown & Associates, Midland, Tex., producing firm, as district geologist in the company's new Roswell district exploration office.

Jack Holzman has been transferred by Shell Oil Co. from Los Angeles to Salt Lake City, where he will be district geologist.

DEATHS

Edward S. Diggs, 67, retired assistant to the general manager of marketing with the old Esso Standard Oil Co., died December 2 at his home in Bronxville, N. Y. Diggs was southern regional manager and central regional manager for Esso Standard before becoming assistant to the marketing general manager. He retired in 1958.

William R. Duncan, 36, field superintendent for Well Completions, Inc., Denver, died December 6 after a short illness. He joined Well Completions in 1955 and had been field superintendent for air and gas drilling operations since 1959.

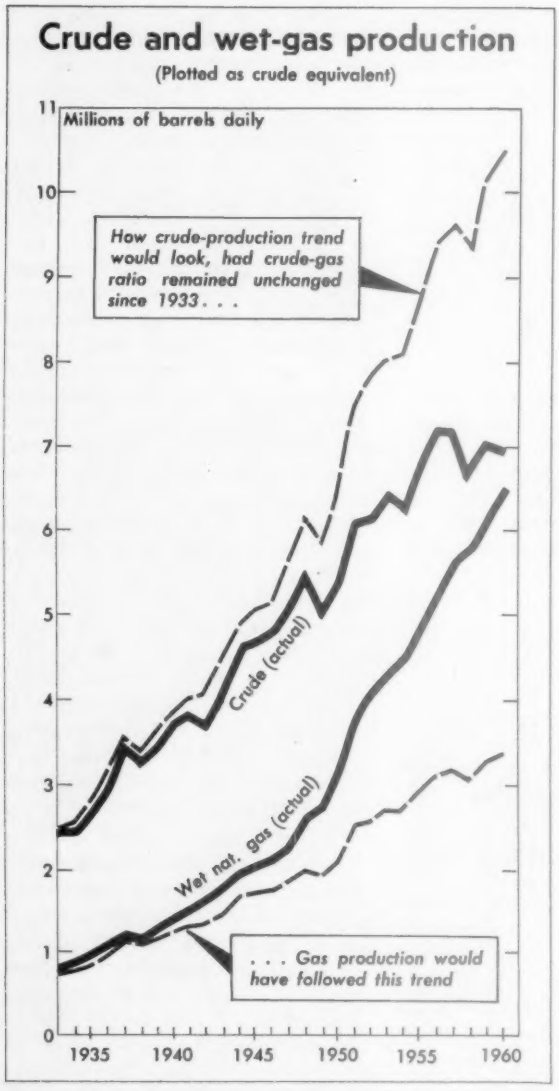
W. M. (Bill) Connor, sales representative for LubriKup Co., died November 29 in a Tulsa hospital after suffering a heart attack.

James Samuel Dismukes, 54, geologist with Humble, died December 4 in a Corpus Christi, Tex., hospital, after a heart attack.

William B. Prugh, 70, Kansas City and Tulsa oil man, died December 9 at his home in Kansas City. Prugh headed Prugh Oil Co. before its sale to Livingston Oil Co. in 1956.

Leslie Alan Rowland, 77, retired vice president and general manager of Deere & Co.'s Grand River chemical division, died December 12 at his home in Tulsa of a heart attack. Rowland came to Oklahoma in 1952 to supervise construction of the Deere chemical plant near Pryor.

A. D. Davidson, assistant drilling superintendent for Amerada Petroleum Corp. in Casper, Wyo., died December 7 at Roundup, Mont., after suffering a heart attack.



Needed: ground rules for study of crude vs. gas

BY JOHN C. CASPER

MAJOR SHIFTS in the energy market produce problems. Problems promote investigations. Investigations call for scores of comparisons.

One of the growing problems in the petroleum industry is related to the keen competion between distillate fuel and natural gas in the home-heating market.

In the postwar period distillate sales increased faster than sales of other major products. This shift in demand called for changes in refinery yields.

In 1946, refiners made 16.6% of the average barrel of crude into distillate fuel. By 1957, distillate yield was up to 23.1%. Despite this higher yield per barrel of crude, growth in distillate demand was an important factor in the steady growth in demand for crude.

But availability of natural gas at controlled prices, and a vigorous selling program by gas distributors made natural gas a strong competitor in the home-heating market. The slowdown in growth of demand for distillate fuel resulted in smaller gains in demand for total petroleum products. Slower growth rates for demand meant slower growth rates for crude.

Changes in imports of crude and products also influenced crude production rates, but for today we are talking about gas.

Producers sell both crude and gas, but they get more money for a B.t.u. of crude than for a B.t.u. of gas. So, any shift from crude to gas without an increase in total volume results in a cut in producer income. Mr. producer has been looking for some way to evaluate the influence of gas on his income pattern.

As a starter, hundreds of staff employes will be asked to determine how much crude has been displaced by natural gas. The problem will be discussed in industry committees and by federal bureaus.

Before consistent answers can be developed, someone will have to lay down ground rules.

The chart on this page does not give the answer to the problem. It shows only the end result after a single assumption.

The two lines near the center of the chart show actual production of crude and gas-gas liquids since 1933 with gas expressed as crude equivalent.

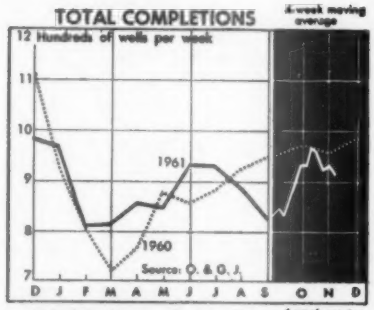
Back in 1933, operators produced about three times as much crude as gas and gas liquids. If production had remained at that ratio through 1960, crude output for the year would have averaged more than 10 million barrels daily. Gas production would have been near the actual rate for 1950.

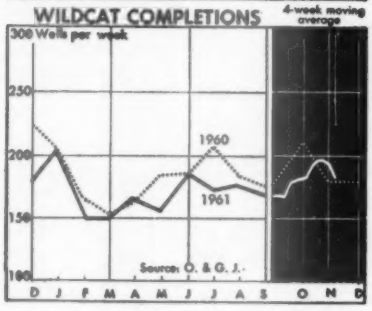
If you give your staff the problem of finding how much crude has been displaced by gas, at least give it a reference point to start from.

A quick look at the highlights . . .

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,379,635	UP	187,105	UP	215,070
Crude stocks	248,190,000	DOWN	610,000	UP	9,899,000
Completions	876	DOWN	109	DOWN	281
Refinery runs	8,291,000	DOWN	182,000	UP	404,000
Gasoline stocks	187,466,000	UP	1,232,000	UP	330,000
Kerosine stocks	35,084,000	DOWN	1,018,000	DOWN	269,000
Distillate stocks	169,118,000	DOWN	4,643,000	UP	2,080,000
Residual stocks	47,524,000	DOWN	8,000	DOWN	1,296,000
Four-product stocks	439,192,000	DOWN	4,437,000	UP	845,000
Total imports	1,983,600	UP	28,500	UP	41,400

Active rotary rigs





	12-11-61	12-4-61	12-12-60
Alabama	8	7	6
Alaska	8	9	4
Arkansas	18	18	9
Arizona	....	2	1
California	116	120	83
Land	112	115	81
Offshore	4	5	2
Colorado	28	39	31
Florida	1	1	4
Land	....	....	2
Offshore	1	1	2
Georgia	....	....	2
Illinois	46	42	40
Indiana	5	7	13
Kansas	137	122	127
Kentucky	4	4	3
Louisiana	293	293	274
North	34	32	35
S. Inland waters	107	114	94
S. Land	89	86	96
Offshore	63	61	49
Michigan	27	21	34
Mississippi	70	68	53
Missouri	....	....	2
Montana	32	27	31
Nebraska	30	29	21
Nevada	1	1	1
New Mexico	112	105	112
New York	3	3	2
North Dakota	14	16	15
Ohio	8	8	6
Oklahoma	232	216	207
Pennsylvania	12	10	12
Tennessee	....	....	1
Texas	707	673	657
S. Inland waters	14	15	7
S. Land	192	192	192
Offshore	3	3	2
North	64	58	66
Panhandle	61	55	56
East	67	63	52
West Central	171	165	160
West	135	122	122
Utah	40	36	32
Washington	1	1	1
West Virginia	16	14	6
Wisconsin	....	....	1
Wyoming	67	72	....
Total U. S.	2,036	1,964	1,863
Cum. avg. to date	1,752	1,746	1,743
Western Canada	167	145	163
Grand total	2,203	2,109	2,026

Hughes Tool Co. report.

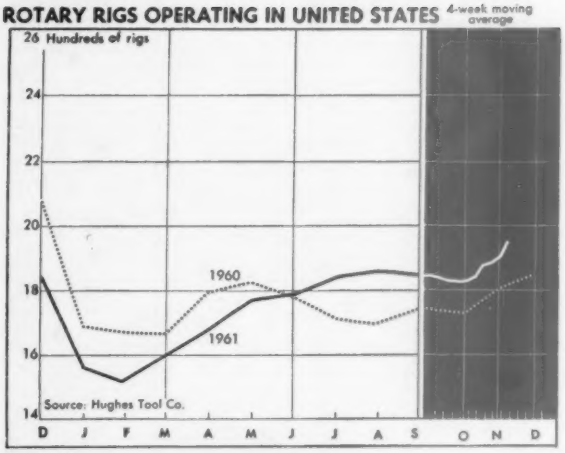
Weekly well completions . . . Week ended December 9, 1961

	Total wells							Cum.		Total wildcats					Cum.	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1961	1960	Total	Crude	Cond.	Gas	Dry	1961	1960
Arkansas	11	6	0	2	3	0	43,669	503	586	0	0	0	0	0	102	144
California	63	44	0	3	15	1	247,082	1,785	1,633	11	0	0	0	11	260	289
Colorado	9	1	0	0	8	0	31,315	625	637	4	0	0	0	4	280	315
Illinois	33	13	0	1	19	0	76,289	1,934	2,225	7	0	0	0	7	451	471
Indiana	24	8	0	1	14	1	33,237	752	1,003	4	0	0	0	4	202	354
Kansas	59	21	0	6	29	3	197,588	4,463	3,961	13	2	0	1	10	825	1,006
Kentucky	11	4	0	0	6	1	14,435	1,670	2,052	0	0	0	0	0	121	214
Louisiana	82	42	0	14	26	0	599,784	3,739	3,482	14	0	0	0	14	644	528
North	44	22	0	3	19	0	129,147	1,613	1,374	10	0	0	0	10	323	257
South	28	14	0	9	5	0	362,520	1,617	1,638	4	0	0	0	4	269	237
Offshore	10	6	0	2	2	0	108,117	509	470	0	0	0	0	0	52	34
Michigan	12	0	0	3	9	0	30,174	775	891	9	0	0	0	9	284	245
Mississippi	9	2	0	0	7	0	97,124	534	644	6	2	0	0	4	190	252
Montana	3	1	0	0	2	0	17,032	376	323	3	1	0	0	2	175	155
Nebraska	13	3	0	0	10	0	63,224	925	824	7	0	0	0	7	463	363
New Mexico	38	18	0	10	7	3	190,317	1,715	1,761	3	0	0	0	3	277	244
West	16	3	0	9	1	3	63,340	743	643	0	0	0	0	0	92	69
East	22	15	0	1	6	0	126,977	972	1,118	3	0	0	0	3	185	175
North Dakota	2	0	0	0	2	0	12,102	241	273	2	0	0	0	2	69	80
Ohio	15	7	0	1	5	2	39,819	1,012	1,017	0	0	0	0	0	41	49
Oklahoma	98	53	1	4	26	14	293,528	5,388	4,487	6	0	0	0	6	490	675
Texas	244	111	0	14	111	8	1,152,564	13,602	14,727	72	12	0	3	57	2,934	3,019
Dist. 1	19	4	0	0	15	0	54,753	873	1,055	10	2	0	0	8	338	373
Dist. 2	13	1	0	3	9	0	99,080	719	721	8	1	0	2	5	222	179
Dist. 3	18	11	0	3	4	0	146,122	1,105	1,106	4	1	0	0	3	232	212
Dist. 4	23	4	0	1	18	0	140,239	1,132	1,006	13	1	0	0	12	324	278
East	15	5	0	1	9	0	109,557	1,081	1,238	6	1	0	0	5	280	256
Dist. 7-B	26	9	0	1	15	1	78,488	1,663	2,099	12	0	0	0	12	465	600
West	71	47	0	1	20	3	370,648	3,422	3,770	15	4	0	1	10	675	598
Dist. 9	53	26	0	3	20	4	128,048	2,520	2,749	3	1	0	0	2	277	468
Dist. 10	6	4	0	1	1	0	25,629	1,087	983	1	1	0	0	0	121	55
Utah	6	2	0	1	3	0	32,122	225	230	2	0	0	0	2	103	89
West Virginia	29	2	0	26	1	0	66,639	997	810	0	0	0	0	0	7	9
Wyoming	31	18	0	2	11	0	145,433	930	1,007	9	1	0	0	8	358	405
Miscellaneous*	84	29	0	15	6	34	188,734	1,321	1,398	3	0	0	1	2	252	239
Total U. S.	876	385	1	103	320	67	3,572,211	43,512	43,971	175	18	0	5	152	8,528	9,145
Previous week	985	474	3	107	372	29	3,957,074	.....	.....	178	20	1	2	155	.....	.....
Cum. 1961	43,512	19,544	727	4,544	15,844	2,853	178,094,544	.....	.....	8,528	765	82	372	7,309	.....	.....
Cum. 1960	43,971	19,871	1,257	3,741	16,562	2,540	180,327,444	.....	.....	9,145	825	105	314	7,901	.....	.....
Western Canada	68	42	0	8	18	0	315,315	2,210	2,185	13	1	0	1	11	504	565

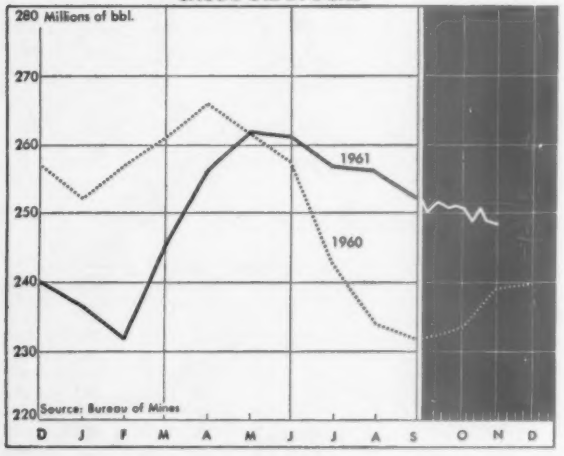
*Pennsylvania, New York, Alabama.

Production

ROTARY RIGS OPERATING IN UNITED STATES 4-week moving average



CRUDE-OIL STOCKS



Crude-oil stocks by states of origin*

(Thousands of barrels)

	12-2-61	11-25-61	12-3-60
Pennsylvania	2,323	2,324	2,330
Other Appalachian	1,406	1,429	1,343
Illinois, Indiana, Michigan	9,855	9,577	9,280
Nebraska and North Dakota	3,412	3,291	2,952
Kansas	9,467	9,425	8,861
Oklahoma	17,130	17,071	14,900
Arkansas	1,981	1,751	1,936
Louisiana	21,372	19,778	18,769
North	3,261	3,502	3,109
South	18,111	16,276	15,660
Mississippi, Alabama, Florida	3,662	3,685	2,196
New Mexico	10,802	10,587	8,553
Texas	103,548	104,634	99,570
East Texas	8,278	8,013	7,317
West Texas	46,075	47,313	46,736
Texas Gulf	18,172	18,604	17,834
Other Texas	31,023	30,704	27,683
Wyoming	15,972	16,043	16,354
Other Rocky Mountain	9,638	9,791	10,355
California	23,372	22,880	26,309
Foreign	†14,250	16,534	14,583
Total	**248,190**	248,800	238,291

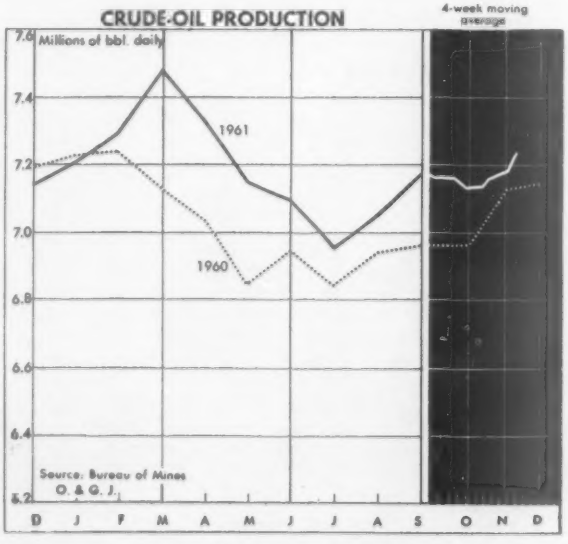
*Bureau of Mines. †Includes 4,328,000 bbl. in California.

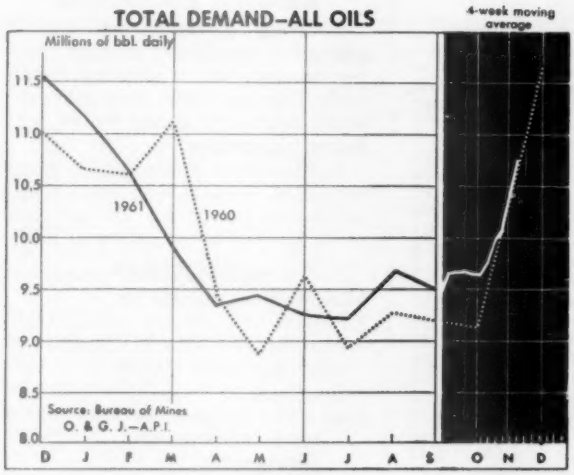
Daily average production for week

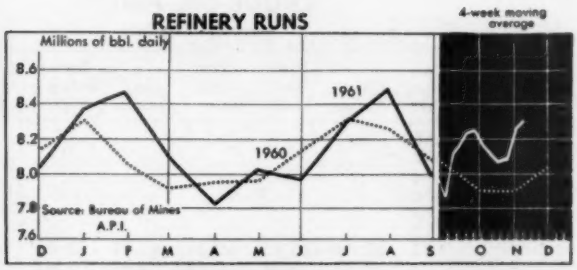
	December 9, 1961 — Crude oil	Lease condensate	Total	Dec. 2 total
Alabama	18,725		18,725	18,750
Alaska	26,600		26,600	26,200
Arkansas	79,600		79,600	79,050
California	816,500		816,500	818,400
Colorado	125,300		125,300	126,400
Eastern	42,000		42,000	40,300
Florida	1,000		1,000	1,000
Illinois	226,400		226,400	221,400
Indiana	30,700		30,700	30,800
Kansas	†310,440		†310,440	†296,640
Kentucky	49,500		49,500	49,800
Louisiana	1,051,000	166,500	1,217,500	1,212,400
North	113,000	16,500	129,500	129,500
South	938,000	150,000	1,088,000	1,082,900
Michigan	52,600		52,600	52,600
Mississippi	147,000	4,300	151,300	150,200
Montana	91,500		91,500	88,900
Nebraska	70,400		70,400	71,250
Nevada	450		450	450
New Mexico	303,000	9,000	312,000	319,000
North Dakota	61,500		61,500	58,400
Oklahoma	†546,250		†546,250	†458,100
Texas	2,540,000	102,670	2,642,670	2,556,350
Dist. 1	41,000	3,500	44,500	45,400
Dist. 2	110,000	8,800	118,800	115,200
Dist. 3	312,000	40,600	352,600	346,600
Dist. 4	185,000	14,000	199,000	193,000
Dist. 5	27,000	1,000	28,000	27,100
Dist. 6	124,000	9,400	133,400	127,700
East Texas field	136,000		136,000	130,000
Dist. 7-B	120,000	700	120,700	120,550
Dist. 7-C	114,000	4,070	118,070	112,700
Dist. 8	1,070,000	13,000	1,083,000	1,033,000
Dist. 9	196,000	5,000	201,000	198,000
Dist. 10	105,000	2,600	107,600	107,100
Utah	91,100		91,100	95,400
Wyoming	414,800		414,800	408,500
Others	‡800		‡800	‡850
Total U. S.	7,097,165	282,470	**7,379,635**	7,181,140
Change from prev. week, up			**198,495**	
Canada	†597,700	†10,600	†608,300	†669,800
Total U. S. Prod.—Jan. 1-Dec. 9				2,462,258,000
Same period last year (crude plus cond.)				*2,417,284,300 bbl.

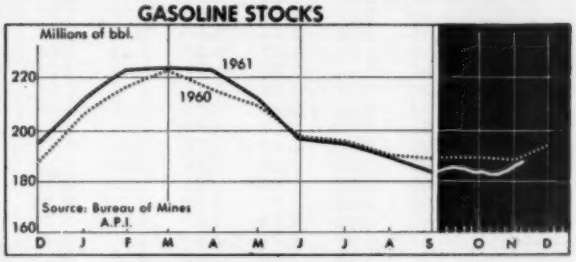
*Includes 77,891,100 bbl. condensate. †Week ended previous Monday. ‡S. Dakota, Arizona, Missouri.

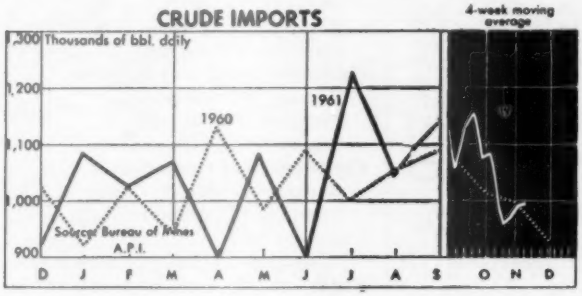
CRUDE-OIL PRODUCTION 4-week moving average

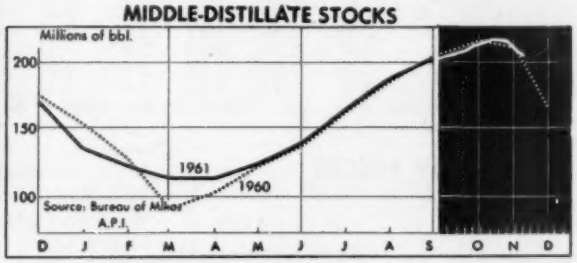


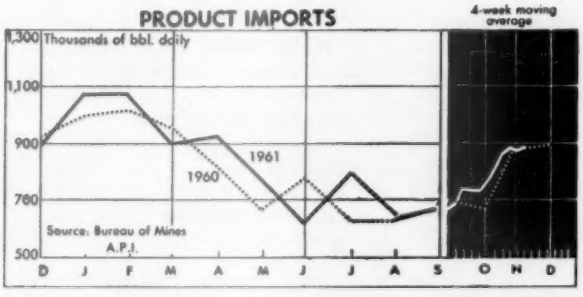


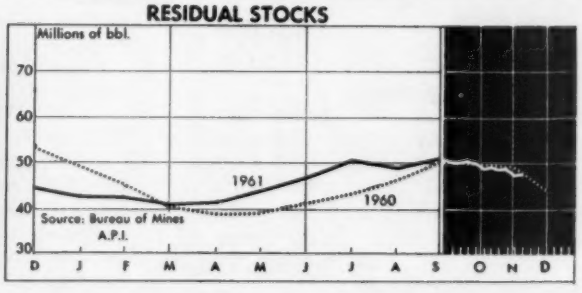












API refinery report—December 8, 1961

(Thousands of barrels)

District—	Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.	Stocks‡—Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, December 1960—Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.
East Coast	1,181	536.7	50.7	376.4	154.6	43,571	14,102	67,091	13,939	1,074.6	498.4	37.1	330.9	164.7
Appalachian:														
District 1	101	42.7	5.7	19.4	11.9	5,581	784	4,164	478	105.8	43.5	4.5	26.5	14.6
District 2	96	51.7	6.6	19.0	12.3	3,114	475	1,778	235	100.0	51.0	7.1	19.1	14.1
Ind., Ill., Ky.	1,536	790.6	70.4	335.4	200.6	31,059	6,890	27,950	5,721	1,486.6	751.9	82.0	327.1	202.7
Minn., Wis., Dak.	120	60.1	7.7	22.4	17.0	6,898	1,857	8,150	614	128.0	60.9	6.8	28.8	22.5
Okla., Kans., Mo.	720	389.1	11.9	196.4	18.4	16,904	1,563	13,553	980	735.4	426.3	18.1	192.8	25.1
Inland Texas	304	218.9	14.1	50.3	18.9	7,032	641	1,627	2,803	284.6	220.2	9.8	45.5	19.9
Texas Gulf Coast	1,823	982.3	126.1	562.6	124.1	24,774	3,513	17,385	4,808	1,883.2	996.9	151.1	511.9	158.0
La. Gulf Coast	790	463.6	79.0	171.4	50.3	10,334	1,857	7,131	1,428	629.3	359.7	68.7	129.1	46.9
N. La. and Ark.	113	67.0	5.6	25.9	6.6	6,274	658	3,242	217	110.0	67.4	4.0	23.8	7.7
Rocky Mountain:														
New Mexico	15	9.4	0.6	1.0	1.9	811	39	197	92	23.9	12.7	0.5	4.1	2.7
Other Rocky Mt.	306	137.6	4.4	70.6	32.0	5,354	508	2,369	1,175	274.8	140.3	4.2	64.6	34.9
West Coast	1,186	502.6	50.1	254.1	246.6	25,760	2,197	14,481	15,034	1,193.7	553.1	37.6	205.6	281.8
Dec. 8, 1961	8,291	4,252.3	433.0	2,105.0	895.0,	187,466	35,084	169,118	47,524	8,029.9	4,182.3	431.5	1,909.8	995.6
Dec. 1, 1961	§8,473	4,439.4	440.9	§2,099.9	919.7	186,234	36,102	173,761	47,532	.....	.....	.....	.....	.....
Dec. 9, 1960	7,887	4,110.1	418.3	1,837.0	951.1	187,136	35,353	167,038	48,820	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines. §Revised.

Prices

CRUDE-OIL PRICES

Gravity schedule

	Signal Hill, Calif.	Oklahoma	West Tex. (sour)	West Tex. (inter.)	No.* Texas	Texas Refugio Light	Bayou Sale (La.)	Denver-Julesburg	Wyo. (sour)
14-14.9	$1.86	....	....	....	....	....	....	....	....
15-15.9	1.93	....	....	....	....	....	....	....	$1.81
16-16.9	2.00	....	....	....	....	....	....	....	1.86
17-17.9	2.06	....	....	....	....	....	....	....	1.91
18-18.9	2.13	....	....	....	....	....	....	....	1.96
19-19.9	2.20	....	....	....	....	....	....	....	2.01
20-20.9	2.27	$2.49	†$2.35	$2.61	$2.29	$2.95	$2.90	‡$2.38	2.06
21-21.9	2.33	2.52	2.38	2.63	2.33	2.97	2.92	2.40	2.11
22-22.9	2.40	2.55	2.41	2.65	2.37	2.99	2.94	2.42	2.16
23-23.9	2.46	2.58	2.44	2.67	2.41	3.01	2.96	2.44	2.21
24-24.9	2.53	2.61	2.47	2.69	2.45	3.03	2.98	2.46	2.26
25-25.9	2.60	2.64	2.50	2.71	2.49	3.05	3.00	2.48	2.31
26-26.9	2.67	2.67	2.53	2.73	2.53	3.07	3.02	2.50	2.36
27-27.9	2.74	2.70	2.56	2.75	2.57	3.09	3.04	2.52	2.49
28-28.9	2.81	2.73	2.59	2.77	2.61	3.11	3.06	2.54	2.54
29-29.9	2.87	2.76	2.62	2.79	2.65	3.13	3.08	2.56	2.59
30-30.9	2.93	2.79	2.65	2.81	2.69	3.15	3.10	2.58	2.63
31-31.9	3.00	2.82	2.68	2.83	2.73	3.17	3.12	2.60	2.67
32-32.9	3.06	2.85	2.71	2.85	2.77	3.19	3.14	2.62	2.71
33-33.9	3.12	2.88	2.74	2.87	2.81	3.21	3.16	2.64	2.75
34-34.9	3.17	2.91	2.77	2.89	2.85	3.23	3.18	2.66	2.79
35-35.9	3.22	2.94	2.80	2.91	2.89	3.25	3.20	2.68	2.83
36-36.9	3.27	2.97	2.83	2.93	2.93	3.27	3.22	2.70	2.87
37-37.9	3.31	2.99	2.86	2.95	2.95	3.29	3.24	2.72	2.89
38-38.9	....	3.01	2.89	2.97	2.97	3.31	3.26	2.74	2.91
39-39.9	....	3.03	2.92	2.99	2.99	3.33	3.28	2.76	2.93
40-44.9	....	3.05	2.95	3.01	3.01	3.35	3.30	2.78	2.95

*Cooke, Grayson, Montague. †Other posting starts at $2.55. ‡Some at 2.58.

FLAT PRICES

Louisiana:
Sweet Lake $3.00

Texas:
East Texas 3.10-3.25
Conroe 3.23-3.53
Van 2.93-3.08

Pennsylvania Grade:
★ Bradford $4.63- 4.80
★ Middle District 4.35- 4.52
★ Southwest Pennsylvania 4.08- 4.25
★ West Virginia 4.00- 4.17
★ Buckeye Grade 3.91- 4.08

Illinois Basin 3.00

FOREIGN

Middle East, Persian Gulf: (cargoes f.o.b. lifting port)
Arabian, 34.0°-34.9°, Ras Tanura $1.80
Iranian, 34.0°-34,9°, Bandar Mashur 1.78
Iranian, 34.0°-34.9°, Abadan 1.73
Iraq, 35.0°-35.9°, Fao 1.72
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi 1.59
Qatar, 41°-41.9°, Umm said 1.95

Middle East, E. Mediterranean:
Arabian, 34.0°-34.9°, Sidon $2.17
Iraq, Mosul-Kirkuk, 35.0°-35.9°, Tripoli 2.19

Far East (cargoes, f.o.b. Lutong, Sarawak):
Seria Light, 36° 2.42

Canada:
Leduc-Woodbend $2.63
Redwater (Alta.) 2.52
Weyburn (light) 2.185
Midale C 1.89

Venezuela:
Cumarebo, 47°-47.9°, Tucupido 3.34
San Joaquin, 40°-40.9°, Puerto La Cruz 3.08
Oficina, 35°-35.9°, Puerto La Cruz 2.80
Tia Juana medium, 26°-26.9°, Amuay* 2.30
Quiriquire, 16.0°-16.4°, Caripito 2.10
Lagunillas heavy, flat, Las Piedras* 2.10
Bachaquero, flat, 15°-16°, Las Piedras* 1.88

Price for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

TANKER RATES (Long ton)

(Latest reported spot fixtures)

★ Gulf-NY, clean (ATRS+12.5%) $3.21
★ Gulf-NY, dirty (ATRS+10%) 3.14
★ Carib.-NY, clean (ATRS—37.5%) 1.72
★ Carib.-NY, dirty (ATRS—55%) 1.24
★ PG-UK, dirty (Scale—57.5%) (26s. 7d.) 3.72

★ Denotes change from previous week.

REFINED PRODUCTS

Following quotations are realistic spot prices for refined products moving interstate on Wednesday each week. They may differ from refinenrs' posted prices and should not be considered as postings.

Light-product prices are in cents per gallon. Residual and crude prices are dollars per barrel. Crude prices are at the well unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):
★ Regular (91 octane) 11.25-11.50
★ Premium (99 octane) 14.00-14.25
†Natural gasoline (26-70) 4.5
†Breckenridge 4.0

Gulf Coast (cargoes for coastwise or export movements):
Regular (90 octane) 10.50-11.00
Regular (92 octane) 10.75-11.25
Premium (98 octane) 11.75-12.25

California (rack) Los Angeles:
Regular (90 octane) 11.20
Premium (94 octane) 12.20
Premium (100 octane) ... 13.35

Caribbean area (cargoes):
Regular (87 octane) 9.00
Premium (97 octane) 11.50

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

KEROSINE DISTILLATE

Mid-Continent (Group 3):
Kerosine 42-44 ..... 10.00-10.25
Diesel oil (58 d.i. and above) 9.50- 9.75
Distillate No. 1 .... 9.50- 9.75
Distillate No. 2 .... 8.75- 9.00

Gulf Coast (cargoes):
★ Kerosine 41-43 ..... 10.00
★ Distillate No. 2 ..... 9.00

New York Harbor (barges):
★ Kerosine 42-43 ..... 11.70
★ Distillate No. 2 ..... 10.70
★ Diesel fuel, 48-52 d.i. 10.85

Caribbean area (cargoes):
Distillate No. 2 ..... 8.10

RESIDUAL FUEL

Mid-Continent (Group 3):
★ Residual fuel (max. 1% S) $1.70- 1.80

Gulf Coast (cargoes):
Bunker C fuel 2.20

New York Harbor (barges):
Bunker C fuel 2.52

Caribbean (cargoes):
Bunker C fuel 2.00

California (rack):
Bunker C fuel, Los Angeles 2.25

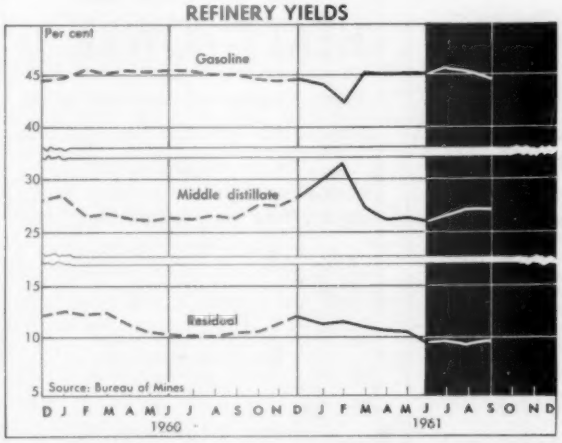
†Due to the decline in market for Grade 26-70 natural gasoline, The Oil and Gas Journal will discontinue publication of prices for this grade of natural gasoline at the end of 1961.

Supply and demand—products

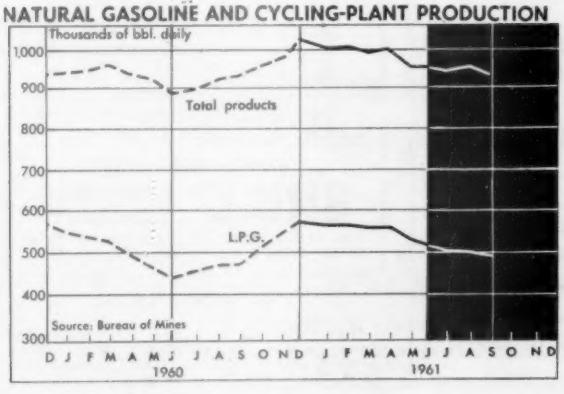
(Thousands of barrels daily)

	Total demand	Refinery production	Stocks end of period
Gasoline			
November 1961	4,170	4,190	186,200
October 1961	4,240	4,130	183,800
September 1961	4,366	4,064	185,000
December 1960	4,054	4,219	194,800
November 1960	4,187	4,089	188,700
Kerosine			
November 1961	450	415	36,100
October 1961	390	410	37,000
September 1961	317	375	35,900
December 1960	607	431	31,400
November 1960	426	413	36,700
Distillate			
November 1961	2,215	2,009	173,800
October 1961	1,570	1,930	178,500
September 1961	1,385	1,819	165,400
December 1960	3,103	1,910	138,500
November 1960	2,070	1,829	173,900
Residual			
November 1961	1,630	867	47,500
October 1961	1,440	810	49,100
September 1961	1,245	795	50,300
December 1960	1,889	996	44,900
November 1960	1,660	904	49,500

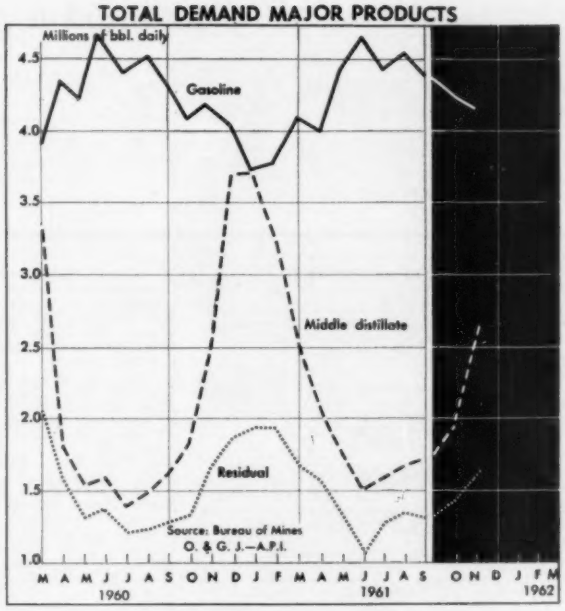
REFINERY YIELDS



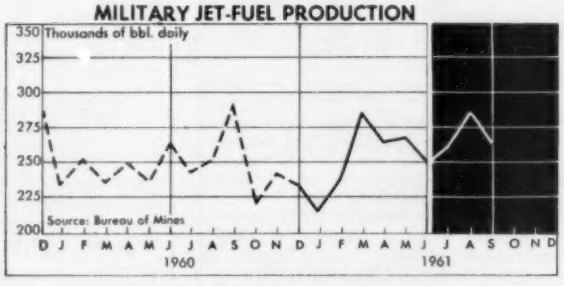
NATURAL GASOLINE AND CYCLING-PLANT PRODUCTION



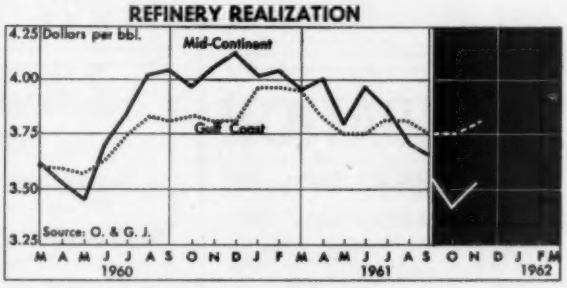
TOTAL DEMAND MAJOR PRODUCTS



MILITARY JET-FUEL PRODUCTION



REFINERY REALIZATION



Refinery realization

	Nov.*	Oct.*	Sept.	Aug.
Mid-Continent	$3.53	†$3.40	†$3.53	$3.67
Gulf Coast	3.81	†3.73	†3.77	3.81

*Preliminary. Refinery realization is based on yields of major products and average spot prices of regular gasoline, kerosine, No. 2 fuel, and residual as published in The Oil and Gas Journal. †Revised.

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Columbus 3, Ohio AX 4-4461

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3—Clark compressors RA 3, RA 6

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DRILL COLLARS. Specs.; 5.5" OD, 2.5 ID, 27' to 30' long, 3.5" IF thread. Will take up to 50 if priced right. Mesker Drilling Company, Box 7465, Tulsa, Okla.

EQUIPMENT WANTED

WANTED: One truck mounted dewaxing unit complete with 3C Kobe, 50-barrel round tank, Butane fired heater. State truck model, condition and price. Paraffin Service, Inc., c/o Stan Brown, P. O. Box 3215, Ventura, Calif., Phone MI 3-9926.

HELP WANTED

PHOTOGEOLOGIST—Balplex Operator—Major oil company has opening in Denver. Send resume of experience and salary expected to Box M-669, The Oil and Gas Journal, Tulsa, Oklahoma.

RESERVOIR ENGINEER—Must have experience in reservoir analysis, evaluation, secondary recovery, and unitization. Excellent opportunity for energetic resourceful man in growing organization. Location in Dallas. Salary commensurate with experience. Please send resume to Hunt Oil Company, 700 Mercantile Bank Building, Dallas 1, Texas; attention Personnel Department.

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has a responsible position requiring a petroleum engineering degree and a minimum of 10 years experience as petroleum engineer.

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Box M-673, The Oil and Gas Journal
Tulsa, Oklahoma

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Leading independent oil company desires aggressive, graduate professional engineer with minimum of 10 years experience in planning, engineering and supervising offshore and high-pressure drilling, completing and producing operations. South Louisiana offshore experience mandatory. Age 32-45 preferred. Probable location Lafayette, Louisiana. All replies held in strict confidence.

Send complete resume including salary requirements to:

Box M-666
The Oil and Gas Journal
Tulsa, Oklahoma

HELP WANTED

WANTED: Petroleum or Mechanical Engineer for oil tool design. Experience with the operation of downhole equipment is desirable. State age, education, experience and salary expected. Box M-643, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER

Desired for opportunity affiliate of Standard Oil Company (New Jersey) operating in Libya. Candidates must have degree and at least 6-8 years experience in oil field equipment and general production engineering including installations such as artificial lift systems, pressure maintenance plants, separator stations, and gas gathering system. Liberal employee benefits including home vacations with travel allowances. Interviews will be arranged for qualified candidates. All replies confidential. Send complete resume' of work experience and personal data to:

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HELP WANTED

EXPLORATION COMPANY active in Appalachians will train young college graduate for career in oil business as landman. Send full particulars: Joe Jamar, 507 Commonwealth Bank Bldg., Butler, Pa.

GEOPHYSICIST—Field Party Chief and Interpreter for Seismograph Contractor. Required 7 to 10 years experience with at least 5 years in West Texas and Eastern New Mexico, salary negotiable. Box M-655, The Oil and Gas Journal, Tulsa, Oklahoma.

FOREIGN JOBS: Experienced Petroleum Engineers and accountants needed by client in North Africa. Write: Oil Industry Employment Service, 405 Tuloma Bldg., Tulsa, Okla. LU 7-5974.

ACCOUNTANT—Age—about 35, college degree in Accounting or Business Administration, experienced in all phases of accounting and office management. Company is a medium sized crude oil producer—headquarters in southwestern New York. Resume should be complete as to personal and family data, education, experience, availability and salary required. Qualified candidates will be interviewed in Tulsa. Write Box M-662, The Oil and Gas Journal, Tulsa, Oklahoma.

CHIEF PETROLEUM ENGINEER

WANTED FOR SMALL OPERATION IN SOUTH AMERICA. REQUIRED WIDE EXPERIENCE INCLUDING COMPLETIONS AND PRODUCTION, APPLY TO BELCO PETROLEUM CORPORATION—APARTADO 3153, LIMA, PERU

NATURAL GAS PROCESSING PLANT ENGINEER

Oil company has immediate need for a qualified man with chemical and/or mechanical engineering degree. Require a man of three to five years experience in all phases of natural gas processing plant operation and treatment of sour gas. Duties involve general plant engineering, plant and field operations, laboratory control testing, equipment and process performance tests. Please forward complete resume including salary requirements.

All replies held in confidence.

Box 31 Q 336
The Oil and Gas Journal
4041 Marlton Ave.
Los Angeles 8, Calif.

SITUATIONS WANTED

LIVE WIRE service company engineer—sales/operations experience logging, perforating, fishing, all wireline services—off shore & foreign—best references—available January. Box M-658, The Oil and Gas Journal, Tulsa, Oklahoma.

PALEONTOLOGIST, 44 single, desires overseas position with oil company. 15 years experience, with Teritary and Cretaceous Foraminifera, and ammonites, in California, Colombia and Libya. Some field and wellsite work. Knows Spanish, learning Arabic. Box M-465, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST 32, seven years with Major in Western Canada, presently holding responsible position, desires change to smaller company in Canada or Abroad. Box 31 Q 337, The Oil and Gas Journal, 4041 Marlton Ave., Los Angeles 8, Calif.

EXPERT, COMPLETIONS, production, workovers, recommendations, programs, costs. Proficient most every operation of independent or company. Graduate petroleum engineer, 23 years' experience, now employed, but want change for legitimate reasons. Box M-668, The Oil and Gas Journal, Tulsa, Oklahoma.

OFFICE—Experienced and Aggressive—Age 42—20 Years Experience in Production Office Work, Some Gasoline, Most experienced in Sales, Personnel and Material Management, other helpful training & experience. Box M-667, The Oil and Gas Journal, Tulsa 1, Oklahoma.

GEOLOGIST—PETROLEUM Engineer, age 38. 10 years intensive exploration, development, and production experience Gulf Coast area. Specialized in producing property evaluations, drilling prospect investigations, and assembling drilling deals. Top references. Numerous contacts for acquiring outstanding properties. Desires affiliation with an aggressive individual investment group, or company on a retainer or partnership basis. Box M-670, The Oil and Gas Journal, Tulsa, Oklahoma.

LEASE AND DRILLING BLOCKS

SHALLOW OIL 365 Ft. off set to producing well $50.00 per acre, or ⅛ over ride, near Ada, Okla. Frank Pritchard, Box 10225 Ft. Worth 14, Texas.

WANT TO BUY—Leases, minerals and royalty. Please state terms in first letter, including legal descriptions. Box M-672, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE—or trade for listed securities—320 acre oil lease—27 producing wells—8 gas injection wells—450' Peru sand, lab. report. Glenn Seaborn, Louisburg, Kansas.

FOR LEASE: Oil & Gas rights—625.4 acres—Sec 4, blk 14, H & GN RR Survey, Childress County, Texas. H. C. Hauter, 7015 Rugby, Huntington Park, Calif.

ARIZONA—Big "Helium" lease play. Leases Available near Majors $1.00 acre. Terms—Free Maps. Edward Colson, 1716 W. Devonshire, Phoenix, Arizona.

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DELAWARE CORPORATION formed and serviced American Guaranty Trust Company. P. O. Box 487, Wilmington, Delaware.

PRODUCTION WANTED

ST. LOUIS GROUP with substantial production interested in purchasing primary and secondary oil reserves in Illinois, Indiana, Kentucky or West Virginia. Can handle properties of any size. All replies confidential and all material forwarded will be returned. Box M-654, The Oil and Gas Journal, Tulsa, Oklahoma.

BUSINESS OPPORTUNITIES

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CALIFORNIA Oil and Gas drilling blocks, mergers and acquisitions, joint ventures, buyers and sellers of oil and gas properties, contract land work, appraisals and geological evaluations. George Malekos, Registered and Bonded, P. O. Box 722, San Francisco, Calif.

DO YOU WANT an oil income? Do you have $500.00 to help drill a well? If so I have the lease to drill. For Particulars write: Suite 416 Professional Bldg. Independence, Kansas.

WILL PAY CASH FOR MANUFACTURING OR INDUSTRIAL PLANTS, CONSTRUCTION OR TRUCKING COMPANIES WITH ASSETS $250,000.00 OR LARGER. PRINCIPALS NOT AGENTS. WRITE BOX 8257, DALLAS, TEXAS.

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The Oil and Gas Journal

Box 1260 Tulsa, Okla.

CAPITAL NEEDED

EXPERIENCED PROFESSIONAL geologist needs immediate capital to acquire several outstanding oil-gas producing properties in Texas-Louisiana gulf coast area. No risk—short payout! Ideal for small groups or individuals to participate in a safe profitable oil producing operation. Will be handled under partnership or small corporation format. Full disclosure to all competent and interested parties. Box M-671, The Oil and Gas Journal, Tulsa, Oklahoma.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Land Office, Cheyenne, Wyoming. Notice is hereby given that one parcel of land totaling 151.27 acres, within the known geologic structure of the Medway field undefined, Hamilton County, Kansas, and eight parcels of land totaling 2,793.69 acres within the known geologic structures of the East Mahoney and West Ferris fields, Carbon County, Wyoming, are offered for competitive oil and gas leasing through sealed bids to the qualified bidder of the highest cash amount per acre at 2:00 P.M., MST, February 7, 1962, when bids will be opened. Details of the offering, and how and where to submit bids, may be obtained from the Land Office, Cheyenne, Wyoming. Arvin H. Olswold, Chief, Minerals Section.

LEGAL

THE FOLLOWING announcement is made by virtue of the powers vested in the Ministry of Finance by Order No. 1 of 1943, as amended. 1. The areas situated within the boundaries of District 1 and District 2 as described below are declared as "open" for the submission of proposals for the award of petroleum concessions therein for a period of three (3) months from Dec. 5th, 1961 ("zero date"). 2. (a) Boundaries of District 1: Commencing at the intersection of latitude 16° North and longitude 41° 20' East; thence South along longitude 41° 20' East in a straight line to the intersection of latitude 14° 45' North and longitude 41° 20' East; thence West along latitude 14° 45' North to the intersection of latitude 14° 45' North and longitude 40° East; thence in a North-Westerly direction in a straight line to the intersection of latitude 15° 35' North and longitude 39° 15' East; thence in a North-North-Westerly Direction to the intersection of latitude 16° North and longitude 39° 05' East; thence East along latitude 16° North to the point of origin, the area enclosed in said boundaries being approximately 27,500 square kilometers in area. (b) Boundaries of District 2: Commencing at the intersection of latitude 18° 10' North and longitude 38° 45' East; thence in a South-South-Easterly direction to the intersection of latitude 17° 12' North and longitude 39° 14' East; thence East along latitude 17° 12' North to the intersection of latitude 17° 12' North and longitude 39° 41' East; thence South-East in a straight line to the intersection of latitude 16° North and longitude 41° 21' East; thence West along latitude 16° North to the intersection of latitude 16° North and longitude 39° 05' East; Thence North-North Westerly in a straight line to the intersection of latitude 17° 30' North and longitude 38° 40' East; Thence North-North-Westerly in a straight line to the border between the Empire of Ethiopia and Republic of Sudan; thence along said border to the coast of the Red Sea; thence in a North-Easterly direction in a straight line to the point of origin, the area enclosed in said boundaries being approximately 27,000 square kilometers in area. 3. Any company ("applicant company") desiring to submit a proposal or proposals looking to the award of a concession covering either or both of the Districts described above shall notify the Ministry of Mines in writing. Upon said notification, and against payment of U. S. $1,000 for each District with respect to which requested, the applicant company shall be furnished with all documents required to permit the preparation of a proposal including a form of Contract of Concession, and instructions relating to the procedure to be followed in submitting proposals, and other documents. In addition, information as to exploration activities already carried on within each such District shall be made available to the applicant company. 4. Prior to ("zero date plus three months") proposals may be filed by the applicant company in accordance with the prescribed procedure. All proposals filed before (above date) shall be deemed to be filed simultaneously but shall not, however, create or vest any right in the applicant company, the Imperial Ethiopian Government reserving full right to reject any and all proposals received without cause. 5. All proposals shall be opened in public on ("zero date plus three months and one day"). Address: Ministry of Mines, P. O. Box 486, Addis Ababa, Ethiopia. Ministry of Mines, Imperial Ethiopian Government.

DISCOVERIES

(Continued from p. 141)

California

Butte County:

Sacramento Oil & Gas Co. 1 Parrott Investment Co. SW SW NW 33-20n-1w. Flowed at rate of 4,100 M.c.f.d. through open tool at end of 2 hr., 40 min., drill-stem test of perforated interval at 3,390-95 ft. TD 5,605. New pool discovery in Llano Seco field.

Contra Costa County:

Occidental Petroleum Corp. 1 Keller Estate SE SE NE 35-2n-1w. Completed flowing 1,030 M.c.f.d. through ½-in. choke from perforation in Domengine sand at 1,640-45 and 1,735-58 ft. TD 4,965. Discovery well in Mulligan Hill field.

Kern County:

Richfield Oil Corp. 72-34 KCL L SW SE NW 34-11n-20w. Completed flowing 143 bbl. daily of 45.2°-gravity crude through 9/64-in. choke. Producing interval 6,741-6,829 ft. in Olcese sand. TD 8,354 ft. New pool discovery 1 mile west of Windgap area and ¾ mile southeast of center area of Wheeler Ridge field.

Yolo County:

Phillips Petroleum Co. 1 Swanston center of N½ SE¼ 26-9n-3e. Completed flowing 1,495 M.c.f.d. through 28/64-in. choke from perforated interval in Tehama sand at 2,160-67 ft. TD 11,194 ft. Discovery well in West Sacramento field.

Western Canada

Alberta:

Mobil et al. 6-22 Twining, LSD 6, 22-31-24w4. Pekisko oil discovery. TD 5,548 ft.

Calstan 10-20 North Bantry, LSD 10, 20-18-13w4. Mississippian gas discovery. TD 3,350 ft.

Mic Mac-B.A. 4-7 Twining, LSD 4, 7-33-24w4. Pekisko oil discovery. TD 5,464 ft.

Hudson's Bay 6-1 Garrington, LSD 6, 1-34-4w5. Viking gas discovery. TD 8,628 ft.

Sun-Pure 6-25 Wembley, LSD 6, 25-71-8w6. Cadomin gas discovery. TD 12,-670 ft.

Delta-CPG 7-20 Medicine Hat, LSD 7, 20-13-7w4. Medicine Hat gas discovery. TD 2,400 ft.

Tennessee A-1 11-13 Buffalo Lake, LSD 11-41-21w4. Viking gas discovery. TD 5,913 ft.

Cansalt 11-11 Lindberg, LSD 11, 11-58-5w4. Colony sand gas discovery. TD 1,800 ft.

Saskatchewan:

Kissinger-Canso-Coop 7-2 Canadian Superior, LSD 7, 2-2-32w1. Mission Canyon oil discovery. TD 3,978 ft.

Mobil-B.A. 13-12 South Carievale, LSD 13, 12-1-31w1. Mississippian oil discovery. TD 3,935 ft.

Mobil 9-32 South Grassdale, LSD 9, 32-6-15w2. Mississippian oil discovery. TD 4,542 ft.

Husky D-16-12 Waseca, LSD 16, 12-49-25w3. Sparky oil discovery. TD 1,793 ft.

Montana

Dawson County, Woodrow area:

Texaco Inc. 1 NP "G" (NCT-12), NE SW 17-16n-54e. IPP 276 BOPD, cut 3.4% water, 42.1°, Interlake Silurian 9,137-46 ft.; IPP 26 BOPD, cut 20% water, 39.9°, Red River Ordovician 9,718-33 ft. TD 9,835 ft. PB 9,751 ft. Dual completion, discovery, new field.

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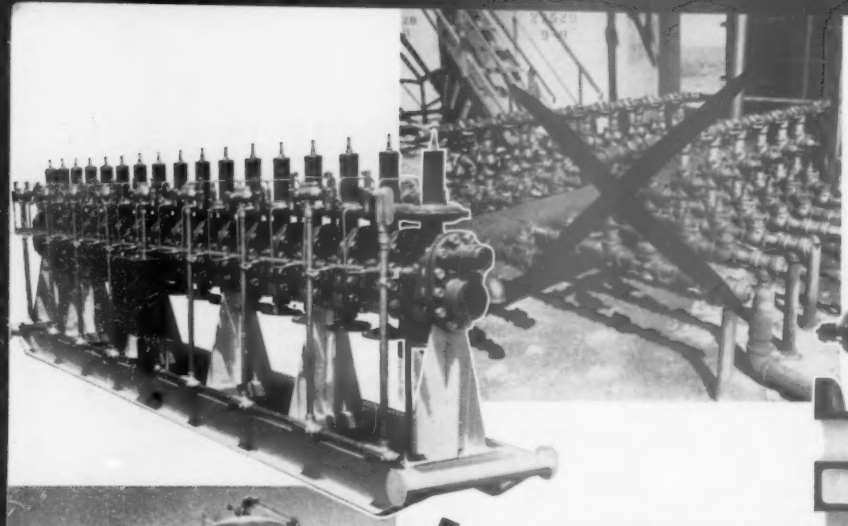
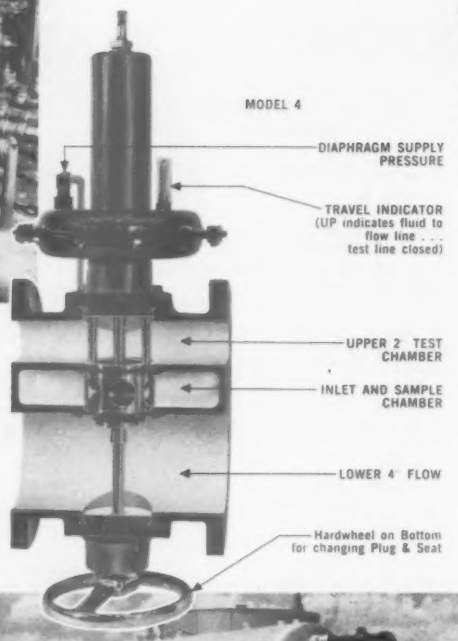
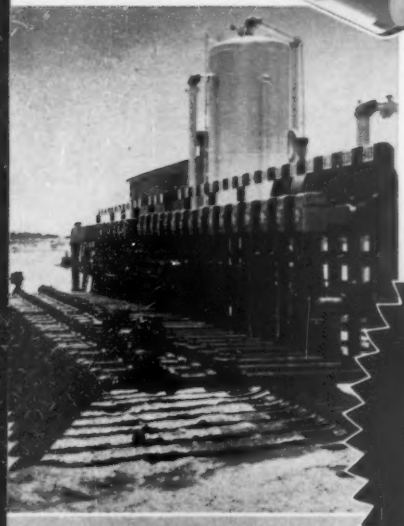




17 Model 4, 600 psi WP MANI-FLO Valves, skid mounted, electro-pneumatic operated with solenoid operators. All wiring in conduit manifold to each valve with central controlled programming in weatherproof control box.



32 Model B, 600 psi WP MANI-FLO Valves installed horizontally in West Texas. Electro-hydraulic topworks consists of a hydraulic pump driven by an electric motor which actuates the plug against the seat.

MANIFOLD WITH NATIONAL® MANI-FLO® VALVES

36 Model 4, 600 psi WP MANI-FLO Valves installed on a National Well Test Unit which automatically programs each of 36 wells in sequence for scheduled test. Electric control panel actuates the pneumatic operated MANI-FLO Valves to place individual wells on test or production.

PATENT PENDING

The MANI-FLO valve, through unique design, lends itself to wide use in the production of oil and gas. Designed primarily for use in lease well production manifolds to eliminate the problems and expenses of conventional arrangements consisting of cumbersome piping, standard valves and fittings, it may also be used as a three-way valve for blending two streams for temperature control; for mixing two different liquids or gases; or as a switching valve to divert flow to different tanks or lines.

In any role or application, MANI-FLO valves may be hydraulically, electrically or diaphragm controlled and sensed by liquid levels, pressures, temperatures, times or differentials of these.

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In 1500 psi WP Valve — 2200 psi Test
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MATERIAL: Body and threaded cover flanges are ductile iron. Pressed steel diaphragm case. Molded diaphragm of best available "nylon reinforced buna." Plug, seat and cage — type 303 stainless steel. Plug has buna N synthetic rubber molded to 303 stainless steel seat to give same sealing characteristics as "O" ring for tight shut-off.

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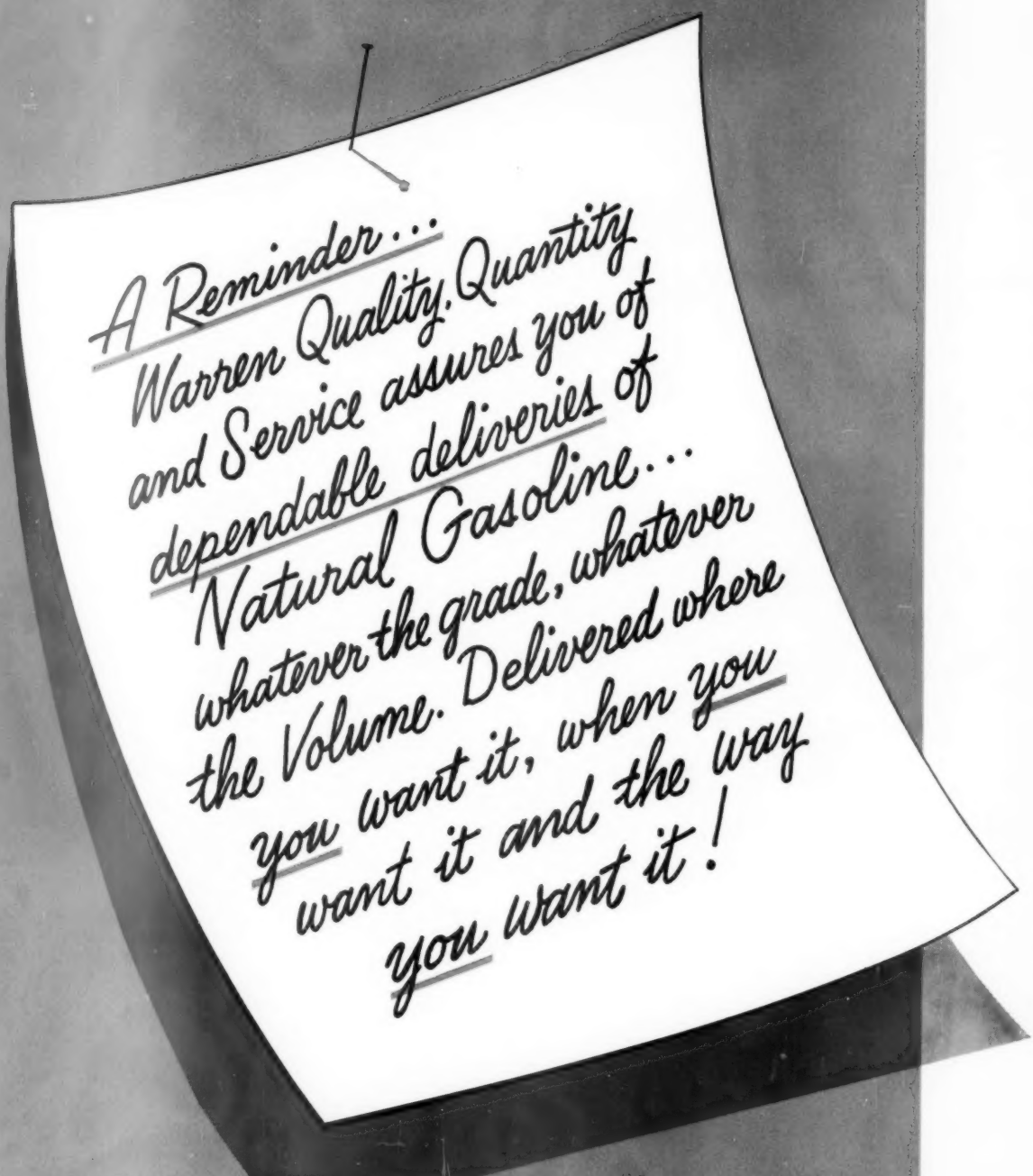
NATIONAL TANK COMPANY

DRAWER 1710

TULSA, OKLAHOMA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